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THE MACKENZIE COUNTRY GRASSLANDS.

PROGRESS OF NATURAL REGENERATION AND EXPERIMENTAL SOWINGS.

R. McGILLIVRAY, F.L.S., Fields Superintendent, Department of Agriculture, Christchurch.

THE condition of the natural grasslands of the South Island is now becoming well recognized as a matter of national importance, and the Mackenzie Country, in the montane part of South Canterbury, has received considerable attention in this respect. When one examines the present state of large parts of the flats and lower hills of this region and visualizes their condition in the early run-holding days of seventy years ago, the retrospective view brings into prominence the very serious deterioration that has here taken place within comparatively recent times.

The Mackenzie Country was early occupied, and considerable burning of the runs took place from about 1860 onward until the early "seventies," by which time much of the work of nature, extending over untold years, had been damaged and in many cases destroyed. During the late "sixties" rabbits appeared and further aggravated the position, but they did not become a very serious pest until about 1877. Their onslaught on the native pastures then commenced in earnest, and depletion of the warm sunny faces and flats was soon in progress, especially where fire had already laid bare tracts of the country. The process of denudation was at first not very rapid, but followed step by step according to the treatment meted out to the vegetative covering by man and the introduced grazing-animals.

In considering the position one has to remember that in these inland regions the climate is one of extremes. The frosts of winter give place in September to drying winds, with a normally high day temperature until the late autumn. With conditions such as these it is not difficult to understand that under certain circumstances depletion was inevitable, and what has taken place in bygone years is not to be altogether wondered at. Indiscriminate burning of the vegetation, overstocking, and the rabbit pest have all contributed their quota towards the nakedness of much of the country to-day. Conditions such as described, together with the natural aridity of the inland plains, plus scorching

FIG. 1. SHOWING REGENERATION OF THE NATURAL GRASSLAND COVER BEGUN.

Establishment of fescue and Poa tussock in seed-bed prepared by growth and decay of scabweed. Grey's Hill Station. (The white patches seen in this photo and in Fig. 3 are snow.)

FIG. 2. DOMINANT FESCUE-TUSSOCK PHASE IN THE REGENERATION NOW PROGRESSING. GRAMPIAN'S STATION.

[Photos by E. B. Levy.

sunshine on the baked surface, have not afforded seedling plants an easy opportunity to reassert themselves and thus reclothe the depleted areas. The prevailing climatic conditions cannot, however, be held primarily responsible for the decline of the native pastures, because even in the localities where depletion is seen at its worst, native grasses are reappearing with the retreat of the rabbit pest. This fact is indisputable, and its significance is of more than passing importance.

It has been pointed out by some observers of the inland native grasslands that the soil now dries out much more rapidly than it did formerly, and that aridity has greatly increased within comparatively recent years. That the soil is drier than formerly — in other words, that it has lost its moisture-retaining capacity—cannot be gainsaid, but the cause is not far to seek. With the disappearance of vegetation the former water-holding capacity of the soil has gone, with the result that the sparse rainfall is not retained, but mostly runs away into the natural watercourses. The dry belt extends up to slightly over the 2,500 ft. level, and on the more exposed situations serious depletion extends even beyond this elevation.

It is unfortunate that there are no definite records of the progress of events that have led up to the present state of the Mackenzie Country, and still more so that remedial measures were not taken at an earlier date. A certain amount of useful work has been done in connection with regrassing, however, and it may be of interest to state the position as it appeared to the writer during several recent visits to the region. To return after an absence of eight years, and to find instead of a still further stage in grassland deterioration a considerable improvement in many parts came as a most pleasant surprise.

The rabbit pest is not now in evidence as it was in 1921, and nature is at work in quite a remarkable manner, native grasses reappearing where the land was practically bare ten years ago. In many parts the scabweed (*Raoulia lutescens*) is thickly studded with vigorous young plants of comparatively recent growth (Fig. 1). The native blue-grass (*Agropyron scabrum*), blue-tussock (*Poa intermedia*), poa-tussock (*Poa caespitosa*), fescue-tussock (*Festuca Novae-zelandiae*), *Poa Maniototo*, and wild-irishman (*Discaria tomatou*) are to be found in seed in places where formally depletion reigned supreme (Figs. 2, 3, 5). These grasses appear to reassert themselves readily with the disappearance of the rabbit, and regeneration will take place over large areas now that conditions are more favourable for plant-growth. The sheep returns reflect the improvement that has taken place, disclosing a healthy increase in the flocks. In 1922 the number of sheep in Mackenzie County was 455,888, while in 1928 the number had risen to 548,781, an increase of 92,893 in six years.

PROGRESS OF EXPERIMENTAL AREAS.

The activities of the Department of Agriculture in connection with regrassing work in the Mackenzie Country commenced in 1910, under the direction of Mr. A. Macpherson, then Fields Instructor at Christchurch. Several areas were fenced and plots sown with various grasses and other plants thought to be suitable for the prevailing climatic conditions. The areas at Whalesback and Haldon are still under the

control of the Department, and during a recent visit a careful examination was made of the introduced vegetation of these areas, also of a sowing that was made on the dark faces of Gallows Hill, Haldon, during September, 1921. This sowing has done remarkably well, and cocksfoot, yarrow, Poa pratensis, and some perennial rye-grass plants are in good healthy condition, despite the fact that sheep depasture on this block all the year round, and that at times the stocking is extremely heavy. Sowings made at the same time on the warm sunny slopes of the same run were not successful.

The Haldon experimental area was established in 1910, and various sowings were made at intervals until about 1915, and again in the spring of 1920. The plots that are showing up well are cocksfoot

FIG. 3. AREA NEAR BURKE'S PASS WITH POA AND FESCUE TUSSOCKS DOMINANT.
Most of this area has regenerated during the last few years. Numerous seedling tussocks show in foreground. This view is typical of the upland plains of the Mackenzie Country.
[*Photo by E. B. Levy.*

(*Dactylis glomerata*), tall oat-grass (*Avena elatior*), Poa pratensis, Chewings fescue (*Festuca rubra* var. *fallax*), yarrow (*Achillea millefolium*), awnless brome-grass (*Bromus inermis*), lucerne (*Medicago sativa*), browntop (*Agrostis tenuis*), sheeps' burnet (*Poterium sanguisorba*), and, in places, white clover.

The Whalesback area shows a most interesting growth of English wild white clover. This was sown in 1911, and now covers several acres of land. In places, in association with Poa pratensis, and in other parts with yarrow, it has formed a splendid sward which completely covers the soil (Fig. 4). Zigzag clover (*Trifolium medium*) was established in 1924 on this area by transplanting a few plants grown

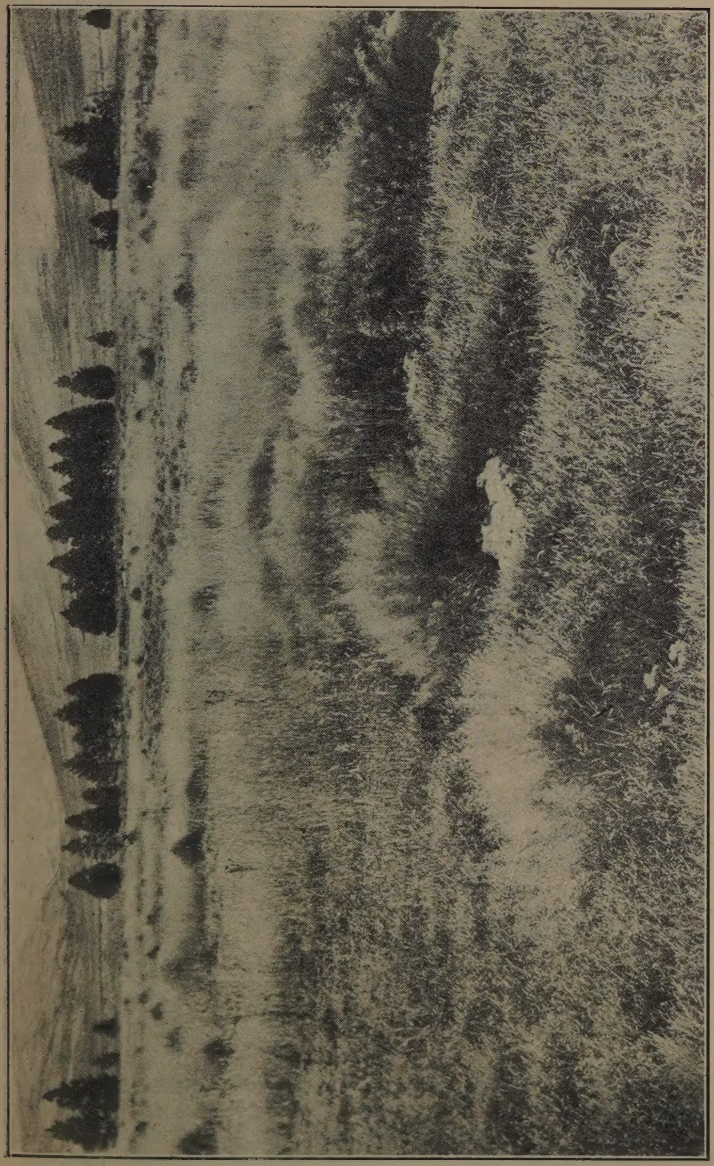


FIG. 4. WHALESBACK EXPERIMENTAL AREA, SHOWING SPELLED PASTURE.
Poa pratensis, brown-top, white clover, and Yorkshire fog are dominant here. [*Photo by E. B. Levy.*

from seed received from Canada. The growth has been prolific, and it promises to be quite a valuable variety for the inland plains. Cocksfoot, tall oat-grass, sheeps' burnet, various fescues, brown-top, red-top, and yarrow have all made good growth.

An extension of spring surface-sowing of the dark faces of the runs with cocksfoot, brown-top, yarrow, Poa pratensis, crested dogstail, and white clover seems to present opportunities for work along lines that promise to be highly successful. The surface sowing at Gallows Hill has certainly been successful, and this work is now more likely to have general success than formerly owing to more favourable general conditions.

FIG. 5. BLUEGRASS (AGROPYRUM SCABRUM) AND WILD-IRISHMAN ESTABLISHING IN SEED-BED FORMED BY GROWTH AND DECAY OF SCABWEED. NEAR BURKE'S PASS.

[*Photo by E. B. Levy.*

At Burke's Pass, the portal of the Mackenzie Country, is erected a monument to the discoverer of the Pass, on which is an inscription exhorting all intending settlers to plant trees. This is sound advice, and though some afforestation work has been done, especially near the Pass, suitable shelter-belts across these upland plains are still urgently required. Besides being of incalculable benefit to both man and beast, they would also afford shelter to the vegetation, and hasten the day both of the regeneration of the native grasses and establishment of exotic pasture.

Stale Cloths and bad Flavour in Cream.—A Farm Dairy Instructor reports: "I have found that a good deal of bad flavour in cream is caused through the use of stale cloths for washing separator parts and utensils, instead of using scrub-brushes. I have also found farmers using stale cloths through milk-pipes, thereby leaving a taint on the pipe which also reacted on the cream. These defects are very often not detected when the cream is delivered daily, but become prominent when it is delivered every second day.

MINERAL CONTENT OF PASTURES RESEARCH.

EXTRACTS FROM REPORT ON WORK FOR YEAR 1928–29.

(Continued.)

B. C. ASTON, Chief Chemist, Department of Agriculture.

Phosphate Deficiency in Wairarapa Localities.

WORK in the Wairarapa district was continued during the year, and the results already obtained (see this *Journal* for October, 1928) have been confirmed—namely, that the poorer pastures of the district are among the lowest in phosphorus content that have been encountered in the course of this research—a fact all the more remarkable when it is considered that they are cow-pastures. The local farming public and agricultural officials have been warned that the deficiency is serious.

Analysis shows that the content of manganese is in some pastures unusually high, approaching 0·1 per cent. Mn_3O_4 on the dried sample. Pastures which have been top-dressed with superphosphate compared with the non-phosphated land on the same farm show great superiority in phosphorus content. Thus at Mauriceville the pasture on non-phosphated areas averaged 0·43 per cent. phosphoric acid, and on the phosphated fields it was 0·62 per cent. At Hamua it was 0·46 per cent. phosphoric acid as against 0·51 per cent. At Hukanui the non-phosphated land gave pasture which varied from 0·2 per cent. to 0·48 per cent. phosphoric acid, as against 0·7 per cent. for the phosphated land. At Masterton the non-phosphated pasture yielded 0·38 per cent. and the phosphated land 0·63 per cent. phosphoric acid.

As bearing on the incidence of disease and low phosphate content of the pastures it will be noted from the tabulated analysis that on hills near Masterton there was as little as 0·27 per cent. of phosphoric acid in the non-phosphated pasture, and that "sleepy" sickness in ewes occurs here. The non-phosphated pastures on a farm at Hukanui, where Waihi disease occurs in cows, had only 0·2 per cent. of phosphoric acid. It will also be seen that the amount of calcium in these pastures was much higher in every case than that of phosphoric acid, and there is apparently no great deficiency of this element in the pasture that one may complain of as likely to have any adverse influence on the health of stock. This is as one would expect from the high clover content of most of the pasture.

NOTES ON THE SAMPLES ANALYSED (SEE TABLE).

Kaituna.

Nos. 6126–27 and 6175: The first two samples from this farm on the slope of the foothills of Mount Holdsworth are compared, and show the influence of phosphate dressings on the botanical and chemical composition of the cow-pastures. The sheep-pasture taken in the spring still shows both low phosphoric-acid and calcium content.

Dalefield.

Nos. 6330–31: The pastures from this farm show the phosphoric-acid content to be low, but the calcium and clovers are present in good amounts.

No. 6346: The low phosphoric-acid content of the pasture on this farm is correlated with much temporary sterility in the cows.

Upper Dalefield.

No. 6332: This pasture, never top-dressed, is extremely low in phosphoric acid.

Greytown.

Nos. 6136 and 6176: In the first sample, a thirty-year-old pasture, although white clover is dominant the phosphoric acid is extremely low. The swamp pasture is a much superior feed.

Belvedere.

No. 6137: A very weedy pasture abnormally low in phosphoric acid, resulting in the occurrence of Waihi disease in the cows. That temporary sterility is mitigated by the application of phosphates on this farm is an interesting but not unexpected result.

Featherston.

Nos. 6134–35: These are rich flat lands in which white clover is dominant in the thirty-year-old pasture, but in which the phosphoric acid is still too low.

No. 6172 and the following two are from farms yielding pasture with the highest phosphoric-acid content yet met with in the Wairarapa.

No. 6173: Another farm with pasture of high phosphoric-acid content, on low-lying country.

No. 6174: On this farm, in spite of the abundance of the clover, the calcium content appears to be lower than that fact warrants.

Mauriceville.

These lands are very near limestone outcrops.

Nos. 6128, 6341–42: From this farm the first two pastures are unmanured and taken in consecutive summers—February, 1928 and 1929. There is close correspondence in the result of phosphoric-acid determination. The estimate of 60 per cent. of clovers is probably too high.

No. 6342: As a result of phosphate manuring the phosphoric-acid content of this grass pasture has been considerably increased.

No. 6343–45: The phosphoric-acid content of the pasture on this farm is low, but evidently improved by liming.

Masterton.

Nos. 6326–27: These pastures, from an upland sheep-run, show abnormally low phosphoric-acid content, with various troubles in the wethers and ewes.

Nos. 6328–29: A farm where the pasture gives satisfactory results in the phosphoric-acid content, showing benefit from manuring with phosphates and with liming.

Nos. 6159–60: This pasture is both poor in phosphoric acid and calcium. One of the few cases of autumn pasture samples, and not much information concerning it.

Table 5.—Analyses of Wairarapa Pastures (Phosphate Deficiency).

[The results are expressed as percentages. Chemical analyses are calculated on the material dried to constant weight at 105° C. in electric oven.]

Lab. No.	Ash.	Crude Silica (SiO_2).	Ferric Oxide (Fe_2O_3).	Alumina (Al_2O_3).	Phosphoric Acid (P_2O_5).	Calcic Oxide (CaO).	Magnesic Oxide (MgO).	Manganese Oxide (Mn_3O_4).	Chlorine.	Nitrogen.	Proteins.	Sodic Oxide (Na_2O).	Potassic Oxide (K_2O).	Botanical Analyses. Grasses.	Legumes.	Weeds.	Date collected.	Manurial Treatment.	Locality.
6126	7·44	1·75	0·025	0·081	0·36	1·08	0·43	0·045	0·66	2·13	13·3	0·16	1·86	60	30	10	1/2/28	1926: Top-dressed with 2 cwt. grass mixture per acre. 1928: Top-dressed with 2 cwt. super	Kaituna.
6127	6·96	2·52	0·022	0·077	0·20	0·89	0·49	0·045	0·54	1·14	7·1	0·06	0·97	90	..	10	1/2/28	Unmanured	Kaituna.
6175	8·91	4·21	0·040	0·157	0·45	0·60	0·32	0·057	0·51	2·49	15·6	..	..	..	..	..	13/10/28	Un-top-dressed	Kaituna.
6330	11·05	2·45	0·039	..	0·64	1·87	0·57	0·042	1·00	3·00	18·8	0·44	2·90	48	40	12	19/2/29	Unlimed. Small dressings super in places	Dalefield.
6331	9·75	1·68	0·040	..	0·55	1·93	0·55	0·014	0·98	3·42	21·4	0·46	2·44	42	47	11	19/2/29	1924: Put down with 20–25 cwt. lime. Annually treated in spring with 3 cwt. lime and in autumn 2 cwt. lime	Dalefield.
6332	7·11	2·54	0·017	..	0·24	1·00	0·46	0·064	0·91	1·31	8·2	0·26	1·63	75	4	21	19/2/29	Unmanured. Surface-sown	Upper Dalefield.
6346	10·77	4·15	0·075	..	0·53	1·21	0·54	0·030	0·92	2·83	17·7	0·32	2·41	75	20	5	23/2/29	Manured last three years with 2½ cwt. super	Dalefield.
6136	9·26	2·84	..	..	0·44	0·94	0·66	0·098	1·18	2·45	15·3	..	..	40	60	..	1/2/28	..	Greytown.
6176	8·74	1·69	0·014	0·045	0·79	0·54	0·48	0·050	1·27	4·06	25·4	..	..	..	..	..	13/10/28	Unmanured	Greytown.
6137	8·90	2·87	0·042	0·135	0·25	1·03	..	0·095	1·01	1·59	9·95	..	..	25		75	1/2/28	Un-top-dressed	Belvedere.
6134	10·99	2·74	0·060	0·180	0·63	1·53	0·72	0·047	1·27	3·34	20·9	..	..	60	40	..	1/2/28	1927 (June): 3 cwt. limestone and super (3 : 1)	Featherston.

REMARKS.

Lab. No.

6126 Waihi disease. Pasture twenty-five years old, rich in clover and fiorin. Porous light-brown soil, on sandstone and shingle. In 1927 cows late in coming in season; fed with bran and super. First crop turnips badly affected with club-root.

6127 Fiorin dominant. Un-top-dressed paddock of No. 6126 farm.

6175 Short sheep-feed; carrying a number of young cattle. Low foothills beneath Mount Holdsworth. Mossy and dry, with little spring growth.

6330 Flooded annually and rather damp. Five cows out of twenty-five usually returning to bull. White clover and dogstail common.

6331 Fairly short and dry growth. Flat silty ground. Floods less than No. 6330.

6332 Very poor dry pasture from strong fern terrace. Only trace of clover.

Lab. No.

6346 Temporary sterility very bad. Low-lying alluvial flats. Rather short and dry growth on grazed patches.

6136 Old pasture — possibly thirty years. White clover dominant. Willows and poplars will not grow here.

6176 Old pasture—tall fescue, small rushes and sedges. Partly drained swamp. No trouble since feeding concentrates, bonemeal, and super.

6137 Grazed but not relished—75 per cent. weeds. Waihi disease. A paddock was top-dressed and opened to the cows, and with bran has resulted in the cows holding.

6134 Rich ground, annually covered with silt from the Ruamahanga. Night paddock about thirty years old. Grazed very short, leaving only good sheep-feed.

Table 5.—Analyses of Wairarapa Pastures (Phosphate Deficiency)—continued.

[The results are expressed as percentages. Chemical analyses are calculated on the material dried to constant weight at 105° C. in electric oven.]

Lab. No.	Ash.	Crude Silica (SiO_2).	Ferric Oxide (Fe_2O_3).	Alumina (Al_2O_3).	Phosphoric Acid (P_2O_5).	Calcic Oxide (CaO)	Magnesic Oxide (MgO).	Manganese Oxide (Mn_3O_4).	Chlorine.	Nitrogen.	Proteins.	Sodic Oxide (Na_2O).	Potassic Oxide (K_2O).	Botanical Analyses. Grasses.	Legumes.	Weeds.	Date collected.	Manurial Treatment.	Locality.
6135	11·69	3·05	0·057	0·120	0·60	1·23	0·56	0·038	1·26	3·28	20·5	..	..	50	50	..	1/2/28	Un-top-dressed	Featherston.
6172	11·26	2·10	0·065	0·163	1·14	0·79	..	0·026	1·23	5·43	33·9	..	..	..	..	..	13/10/28	Unmanured	Featherston.
6173	11·93	2·52	0·124	0·340	1·16	0·76	0·44	0·023	1·22	5·31	33·2	..	..	..	..	..	13/10/28	1926 and 1928: 1¼ cwt. super	Featherston.
6174	11·72	2·65	0·085	0·243	1·14	0·53	0·50	0·029	1·04	5·40	33·8	..	..	..	..	..	13/10/28	..	Featherston.
6128	11·10	3·25	0·092	0·212	0·37	1·87	..	..	0·87	2·04	12·7	..	..	30	60	10	1/2/28	Very little top-dressing. Unlimed ..	Mauriceville.
6341	8·67	2·15	0·026	..	0·44	2·59	0·35	0·030	0·99	2·13	13·3	0·28	1·73	58	20	22	22/2/29	..	Mauriceville.
6342	10·06	1·69	0·026	..	0·64	1·94	0·51	0·049	0·81	2·91	18·2	0·22	2·93	44	39	17	22/2/29	1924: 4 cwt. super	Mauriceville.
6343	7·35	1·75	0·016	..	0·59	1·17	0·39	0·046	0·93	2·09	13·1	0·22	2·10	89	10	1	22/2/29	1925: 3 cwt. super. 1927: 2 tons lime and 3 cwt. slag. 1928: 3 cwt. super	Mauriceville.
6344	7·29	1·84	0·017	..	0·47	1·03	0·44	0·033	0·93	1·99	12·4	0·12	2·27	88	10	2	22/2/29	Unlimed. Manured as No. 6343 ..	Mauriceville.
6345	8·18	2·71	0·016	..	0·44	0·90	0·52	0·101	0·94	2·00	12·5	0·14	2·21	88	7	6	22/2/29	Unmanured	Mauriceville.
6326	8·15	3·43	0·014	..	0·40	0·69	0·33	0·061	0·97	1·82	11·4	0·16	1·82	91	5	4	19/2/29	Unmanured	Masterton.

REMARKS.

Lab. No.

6135 Day paddock thirty years old. Grazed, but not so short as No. 6134. White clover similarly dominant.

6172 Temporary sterility in 1927; eclampsia in 1928. Rich-looking pasture. Old flax-swamp paddocks; green new growth.

6173 Dairied sixty years. Temporary sterility in 1927; eclampsia in 1928. Rich growth, young and green. Swamp paddocks.

6174 No trouble. Stocked heavier and more hay feed. Short, green, new feed, harder and poorer looking than Nos. 6172 or 6173. Alluvial stony flats. Abundance of white and subterranean clovers.

6128 Cows clean except for possibility of cystar ovaries. Four or five returned to bull. Pasture forty years old; white clover dominant. No calcium or phosphate fed.

Lab. No.

6341 Very little trouble. Same as No. 6128. Limestone soil. Medium growth; great mixture.

6342 Low-lying alluvial flats. Mixture of weeds, grasses, and clovers; rather long and green in places.

6343 Pasture rather long and dry.

6344 Unlimed paddock of No. 6343. Similar growth to No. 6343, but rather longer.

6345 Hill country, possibly limestone. Native grasses; rather long, dry feed.

6326 Undulating papa hills, sown from bush eighteen years ago. Pizzle-rot and trouble with fat lambs.

Mangamahoe.

No. 6335: A neglected paddock, showing a very low phosphoric-acid content of the pasture.

Hamua.

Nos. 6129–30 and 6337 are pastures from the same farm. Those from the phosphated paddocks are much superior in phosphoric acid to that from the non-top-dressed paddocks.

No. 6337, taken in the same month a year later on a limed paddock, still shows the characteristic low phosphate content.

No. 6131: The pasture of this farm shows low phosphoric-acid content in spite of top-dressing.

No. 6133: The high proportion of clovers in this pasture and the low percentage of phosphoric acid is remarkable on this farm.

No. 6336: This farm yields a pasture which contains the highest phosphoric-acid content yet found at Hamua. It is to be noted as significant that very little difficulty is experienced with the cows as regards breeding troubles.

The farms of this locality, except those on distinctly recent alluvial soils, are much affected with temporary sterility in the cows. The pastures of those farms which escape lightly or are at present immune from breeding troubles contain the most phosphoric acid of any, but the amounts present are still too low for normal cow-pastures. These low figures for phosphoric acid are remarkable considering the high clover content of the pastures. The calcium content of the Hamua pastures is uniformly high. The use of superphosphate for these pastures must be urgently commended, since those paddocks top-dressed with phosphates show a much higher phosphate content than those which have not been top-dressed. All of the pasture samples were more or less contaminated with earthy matters, so that the iron, alumina, and manganese figures are probably in excess of those actually occurring in the plant tissue.

Hukanui.

Nos. 6132, 6338, and 6339: At Atea is a farm on which Waihi disease (bone malnutrition in cows) occurred, and here the extraordinarily low figure of 0·2 per cent. is obtained for the amount of phosphoric acid in the pasture. It is to be noted that here the clovers are absent and the calcium content sinks. The following year, in the same month, analysis of pasture shows a similar low phosphoric-acid and calcium content, and the clovers similarly deficient. Where the land has been top-dressed with phosphates after ploughing, phosphoric acid, calcium, and clovers in the pasture all show a healthy increase on this farm. Manganese is present in high amount in this example.

No. 6340: At Nireaha, on a recent alluvial soil, a very high manganese content of the pasture is again met with. How far this is due to contamination of soil is difficult to say.

Eketahuna.

Nos. 6333–34: These two pastures from the same farm show great differences in the chemical and botanical composition, and again draw attention to the need for heavy phosphating of the pasture. The high amount of phosphoric acid (0·85 per cent.) on the annually treated pasture, compared with the very low figure, 0·31 per cent., for the pasture which had only one dressing two years ago is most significant.

Table 5.—Analyses of Wairarapa Pastures (Phosphate Deficiency)—continued.

[The results are expressed as percentages. Chemical analyses are calculated on the material dried to constant weight at 105° C. in electric oven.]

Lab. No.	Ash.	Crude Silica (SiO_2).	Ferric Oxide (Fe_2O_3).	Alumina (Al_2O_3)	Phosphoric Acid (P_2O_5).	Calcic Oxide (CaO).	Magnesic Oxide (MgO).	Manganese Oxide (Mn_3O_4).	Chlorine.	Nitrogen.	Proteins.	Sodic Oxide (Na_2O).	Potassic Oxide (K_2O).	Botanical Analyses. Grasses.	Legumes.	Weeds.	Date collected.	Manurial Treatment.	Locality.
6327	9·38	6·58	0·015	..	0·27	0·42	0·30	0·064	0·57	1·84	11·5	0·06	0·97	96	1	2	19/2/29	Unmanured	Masterton.
6328	9·41	2·82	0·045	..	0·63	1·58	0·60	0·043	0·80	2·54	15·8	0·28	2·34	54	36	10	19/2/29	1925: Sown with 15 cwt. lime and super. 1926: 2 cwt. super. 1927–28: 2 cwt. super and Ephos (1 : 1)	Masterton.
6329	8·49	4·05	0·013	..	0·47	0·93	0·42	0·090	0·78	1·47	9·2	0·18	1·50	84	6	10	19/2/29	Unlimed and unmanured	Masterton.
6335	7·37	2·77	0·023	..	0·25	0·85	0·47	0·081	0·82	1·58	9·9	0·22	1·81	91	2	7	21/2/29	Unmanured	Mangamahoe.
6159	9·55	3·77	0·024	0·062	0·50	0·65	..	0·087	1·29	3·05	19·1	..	..	..	..	..	6/4/28	2 cwt. super when sown	Masterton.
6160	11·40	3·32	0·030	0·126	0·61	0·73	..	0·089	1·66	1·96	12·2	..	..	..	..	..	6/4/28	Unmanured	Masterton.
6129	9·59	1·30	0·036	0·083	0·48	1·48	..	0·030	0·93	2·63	16·4	..	..	70	30	..	1/2/28	1925: Top-dressed with 3 cwt. super. 1926: Top-dressed with 2½ cwt. super. 1927: Top-dressed with 2 cwt. super	Hamua.
6130	9·60	1·60	0·025	0·050	0·29	1·17	0·55	0·028	1·11	2·15	13·2	..	..	70	30	..	1/2/28	Un-top-dressed	Hamua.
6131	9·31	1·37	0·043	0·130	0·38	1·48	0·69	0·022	0·84	2·51	15·7	..	..	..	..	..	1/2/28	Limed and top-dressed	Hamua.
6133	10·28	2·32	0·063	0·203	0·56	1·17	0·67	0·041	0·92	2·41	15·0	..	..	10	90	..	1/2/28	Un-top-dressed	Hamua.

REMARKS.

Lab. No.

6327 Fifty years old. Sandstone formation. "Sleepy sickness" troublesome. Grazed short by sheep and rather dry.

6328 White and red clover dominant. Grazed short; rather dry.

6329 Same soil, &c., as No. 6328, but pasture got away to seed more. Only carrying bull. Danthonia and brown-top dominant.

6335 Stony alluvial flat. Cattle grazed. Brown-top prevalent.

6159 Seven years old. No trouble yet. Mainly cocksfoot and rye-grass; grazed by sheep.

6160 No trouble yet. Pasture not eaten down. Plateau.

Lab. No.

6129 Cows constantly returning to bull. Day paddock six years old; white clover and cocksfoot dominant. Second crop swedes always a failure owing to club-root.

6130 Unmanured paddock of No. 6129. Ploughed land, four to six years old. White clover and cocksfoot dominant.

6131 Sterility. Ploughed two years ago; put down cow-grass and rye-grass with ½ ton ground limestone in autumn, and top-dressed in spring with 1½ cwt. super. Grazed by cows.

6133 Richest farm in district; river silts land over yearly. No trouble till this year (1928). White clover 90 per cent. Small hay paddock top-dressed gave large growth.

Table 5.—Analyses of Wairarapa Pastures (Phosphate Deficiency)—continued.

[The results are expressed as percentages. Chemical analyses are calculated on the material dried to constant weight at 105° C. in electric oven.]

Lab. No.	Ash.	Crude Silica (SiO_2).	Ferric Oxide (Fe_2O_3).	Alumina (Al_2O_3).	Phosphoric Acid (P_2O_5).	Calcic Oxide (CaO).	Magnesi Oxide (MgO).	Manganese Oxide (Mn_3O_4).	Chlorine.	Nitrogen.	Proteins.	Sodic Oxide (Na_2O).	Potassic Oxide (K_2O).	Botanical Analyses. Grasses.	Legumes.	Weeds.	Date collected.	Manurial Treatment.	Locality.
6336	9·56	1·30	0·028	..	0·68	1·53	0·62	0·019	1·13	4·00	25·0	0·49	2·94	58	37	4	21/2/29	Autumn 1928, ½ ton burnt lime; spring 1928, 3 cwt. super. Previously 3 cwt. super for three years	Hamua.
6337	9·07	2·17	0·034	..	0·54	1·37	0·46	0·028	1·07	3·15	19·4	0·12	2·61	66	28	6	21/2/29	Limed	Hamua.
6132	7·41	2·95	0·056	0·167	0·20	0·86	0·32	0·028	0·40	1·65	10·3	..	..	50	..	50	1/2/28	Un-top-dressed	Atea, Hukanui.
6340	9·87	2·95	0·040	..	0·48	1·21	0·63	0·081	1·27	2·58	16·1	..	..	73	14	13	21/2/29	Unmanured	Nireaha, Hukanui.
6338	9·27	2·36	0·035	..	0·69	1·12	0·57	0·090	1·29	3·32	20·7	0·61	2·16	77	14	9	21/2/29	Ploughed 1924, and 2 3 cwt. super annually since	Atea, Hukanui.
6339	7·82	3·14	0·021	..	0·26	0·75	0·43	0·022	0·66	2·03	12·7	0·34	1·66	80	1	19	21/2/29	Unmanured	Atea, Hukanui.
6333	8·06	2·13	0·015	..	0·31	1·05	0·42	0·054	0·94	1·90	11·9	0·31	2·07	79	6	15	20/2/29	1927: 2 cwt. super	Eketahuna.
6334	10·50	1·92	0·032	..	0·85	1·69	0·56	0·028	1·27	4·05	25·3	0·58	2·93	51	43	7	20/2/29	Put down 1922 with 2 cwt. agricultural lime and manure. 1923–25, 2 cwt. slag annually; 1926–28, 2 cwt. slag and 3 cwt. burnt lime annually. 1924, 2 cwt. super also	Eketahuna.

REMARKS.

Lab. No.
6336 Very little trouble. Short green feed on alluvial flats. Rye-grass and white and red clovers dominant.
6337 Short rather dry feed with many thistles.
6132 Waihi disease, 1927; none 1928. Light loam on sandstone and shingle, with western aspect. Bush country. Fiorin and moss dominant. Top-dressing makes clover come away well.
6340 Stony alluvial flats. Cocksfoot dominant.
6338 Adjoining No. 6132, and similar soil, history, and age. Grazed short and green. Brown-top, cockstoot, and white clover dominant.
6339 Upper flats and slopes of hills. Very poor feed for sheep or cattle. Danthonia dominant.
6333 Short and somewhat dry feed; brown-top, danthonia, and cocksfoot dominant.
6334 Short green feed; white clover, trefoil, and red clover dominant.

Samples collected by R. E. R. Grimmett and C. M. Wright. Chemical analyses by B. C. Aston, Misses Kidson and Strand, and assistants. Botanical analyses of Nos. 6126 to 6130 and 6132 to 6137 estimated by C. W. Wright in field; others done in laboratory.

ERRATA.—In Table 1, p. 21, July *Journal*, the last three constituents—ferric sesquioxide, aluminium sesquioxide, and calcic oxide—should also read as present in crude silica. In heading of Table 3, page 24, Calcic oxide (CgO) should read Calcic oxide (CaO).

DRY-ROT OF SWEDES.

SOME FIELD OBSERVATIONS AND EXPERIMENTS ON CONTROL.

J. C. NEILL, Field Mycologist, Plant Research Station, Palmerston North.

IN G. H. Cunningham's bulletin, "Dry-rot of Swedes and Turnips: Its Cause and Control*," it is demonstrated by laboratory methods that the disease is carried in the seed, and that such seed can be disinfected by soaking for one hour in a 0·25 per cent. solution of Semesan held at 115° F. Subsequent laboratory experiments showed that the same result could be obtained by soaking the seed cold for one hour, followed by five minutes at 115°, both in 0·25 per cent. Semesan solution. The latter method proved quite harmless to the vigour of germination of even weak seed, and had the advantage of being much simpler to carry out on the average farm.

During the last three years swede-seed has been treated by one or other of these methods for approximately two hundred crops scattered over New Zealand. Following treatment, most of it has been tested for disinfection by Cunningham's method of plating on media ten samples of one hundred seeds from each treated lot, and, though in the aggregate some ninety-five thousand treated seeds have been so tested†, not one dry-rot-infected seed has been found. Nevertheless, the large majority of these crops developed dry-rot, and, where a comparison could be made, usually to the same extent as in the crops from the same seed untreated. It follows, then, that either the seed was not completely disinfected, and that the laboratory tests failed to disclose this fact, or that the crops became infected from some other source.

The most obvious possible source of infection apart from the seed would be a previous crop of swedes or turnips grown or fed on the same land; but this contingency had been carefully guarded against with nearly all the crop examined. Other possible sources of infection are wind-borne spores from distant centres of the disease; continued existence of the dry-rot fungus in the soil for two or more years in the absence of its normal host-plants; presence of the fungus on other hosts than crop brassicas; carriage of the spores from diseased to healthy plants by insects, birds, animals, or man.

Cunningham has shown that dry-rot spores rapidly lose their power of germination when dried out from the gelatinous matrix in which they are extruded, so that wind-borne infection is not likely over long distances. Moreover, the spread of infection within a crop is of a localized or contact type, very different from the generalized dispersal of crop-diseases known to be air-borne.

In regard to the possibility of the fungus carrying over in the soil, Cunningham concludes that infection from this source is not usual. The field evidence appears to support his view, especially the observed

* Bulletin No. 133, New Zealand Department of Agriculture, 1927. (Abridged in this *Journal* for July, 1927.)

† All tests for disinfection were carried out by R. Brien, Culture Specialist for this Station.

fact of crops grown on virgin land carrying approximately an equal amount of dry-rot as those from the same seed grown elsewhere.

The third possibility—that the disease occurs on other host-plants in New Zealand—has as yet received no supporting evidence either in the laboratory or in the field, in spite of five years' search for such an occurrence. The only plants on which the disease has been recorded in New Zealand are swede, turnip, and cabbage, and on the last-named it is exceedingly rare.

There remains the possibility that the disease is carried from one swede crop to another by insects, birds, animals, or man. It is probable that within the boundaries of any particular crop these comprise the main agencies by which infection is spread, but they cannot account for the observed distribution of diseased crops in the field. We have had crops grown in many different localities in both Islands from the same sample of seed, and though the total loss due to the disease might vary with date of sowing, climate, cultivation, &c., the percentage and distribution of the characteristic primary dry-rot patches would remain approximately the same throughout.

The field evidence thus appears to confirm Cunningham's contention that the main primary source of dry-rot infection is carried in the seed, but at the same time it strongly suggests that the seed is not disinfected by the method he advocates or by the modified method given above. It seems probable that the laboratory tests of disinfection, on the apparent success of which both methods were based, failed to disclose the extremely minute percentage of seed which, in the commercial samples used, was capable of producing the disease in the field.

The present article records certain results of a series of treatments of one sample of high-grade English swede-seed carried out during the past season at the Plant Research Station, Palmerston North.

The experiments failed to afford definite evidence as to the success or otherwise of disinfection by the methods tried because of the reasonable doubt as to whether the first-found dry-rot lesions arose from seed sown at those particular spots or not; further, it is doubtful whether the absence of lesions from any particular treatment had any significance, in view of the small number found in the untreated controls. The chief value of the experiments lies in providing a record of the spread of dry-rot infection in a crop, and in the indications they give as to the lines of future work

What is wanted now are supplies of swede-seed (1) from plants free from dry-rot, and (2) from plants heavily infected with dry-rot. It would then be possible to test whether under ordinary New Zealand field conditions clean seed produces a clean crop and infected seed a diseased crop. In the meantime, as a working basis for further disinfection experiments, it is justifiable to assume on the present evidence that diseased seed will produce diseased plants in the field. The present work shows that either such experiments must be carried out on a much more elaborate scale, both in regard to number of plants and to isolation of each treatment, or that seed much more heavily infected than the ordinary commercial sample must be used.

Selected bulbs are now growing at this Station, both under glass and in the open, in an endeavour to produce both disease-free and heavily diseased seed-heads—the latter by methods of artificial inoculation.

PARTICULARS OF EXPERIMENTS.

Area 1.

The land, broken out of part lucerne, part grass, in April, 1928, had not carried brassicas for at least seven years; there were no brassica crops within a mile, but several small household vegetable-gardens within that radius. Manuring was with superphosphate, broadcast at 3 cwt. to the acre. The seed was sown with a Planet Jr. drill on 6th November, in rows 2 ft. apart. Germination was uniformly excellent, approximately 2,000 plants per row developing to first main-leaf stage. At the end of November the plants were thinned to 8 in. apart, leaving 350 plants per row. (The short control row 37 was left unthinned.)

No sign of dry-rot was detected on frequent inspections until 15th January, 1929, when six individual plants showing typical leaf lesions were found at the spots marked on the plan (Fig. 1). The diagnosis was confirmed in cultures, and one of the plants (shown on plan in Row 11) pulled and replanted in the open at the laboratory developed typical bulb dry-rot within a few weeks. By 8th February bulb lesions were becoming common in the vicinity of the first-found leaf lesions. It was decided then to test the possibility of getting rid of the disease by the removal of all infected plants. Careful weekly examinations were made with this end in view, the position of each infected bulb being recorded, together with the date of detection and removal. The plan shows graphically at three salient dates how the disease had spread, and, incidentally, how hopeless is an attempt to check it by this means. It is probable that the spread of infection was helped by the traffic and handling of the plants necessitated by the frequent inspections, but a study of the spread week by week, and the obvious attraction to insects of spore-producing lesions, suggest very strongly that insect carriers are the main source of fresh infections.

Seed Treatments.

Row No.				
6	12 hours in water plus 5 minutes in Semesan at			131°.
7	,,	,,		127°.
8	,,	,,		123°.
9	,,	,,		119°.
10	,,	,,		115°.
11	1 hour in Semesan plus 5 minutes in Semesan at			135°.
12	,,	,,		133°.
13	,,	,,		131°.
14	,,	,,		129°.
15	,,	,,		127°.
16	,,	,,		125°.
17	,,	,,		123°.
18	,,	,,		121°.
19	,,	,,		119°.
20	,,	,,		117°.
21	,,	,,		115°.
22	20 seconds in Semesan at			170°.
22A	Not sown.			
23	60 seconds in Semesan at			160°.
23A	50	,,		160°.
24	40	,,		160°.
24A	30	,,		160°.
25	20	,,		160°.
25A	10	,,		160°.
26	60	,,		155°.
26A	50	,,		155°.

Seed Treatments—continued.

Row No.			
27	40	seconds in Semesan at	155°.
27A	30	,,	155°.
28	120	,,	150°.
28A	100	,,	150°.
29	80	,,	150°.
29A	60	,,	150°.
30	50	,,	150°.
30A	40	,,	150°.
31	30	,,	150°.
31A	20	,,	150°.
32	10	,,	150°.
32A	120	,,	145°.
33	100	,,	145°.
33A	80	,,	145°.
34	Dusted with Semesan.		
34A	Dusted with U.T. 871.		
35, 36, 37	Control untreated.		

Semesan solutions at strength of 0·25 per cent. Temperature of presoak, 55°–60°. All temperatures Fahrenheit.

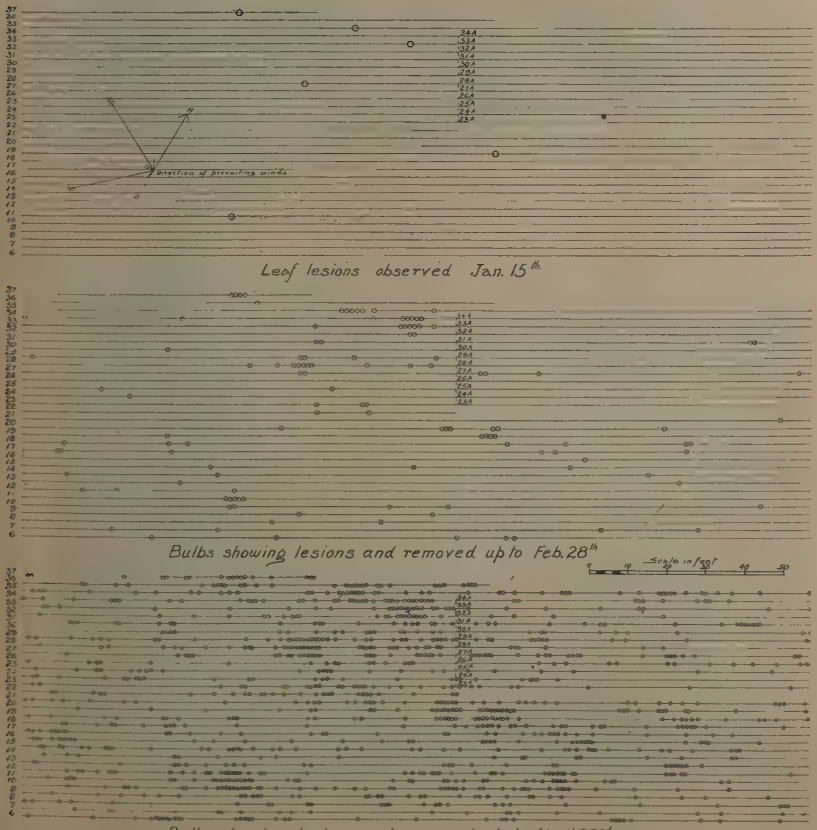

Direction of prevailing winds
Leaf lesions observed Jan. 15th.
Bulbs showing lesions and removed up to Feb. 28th
Scale in feet
Bulbs showing lesions and removed up to April 22nd

FIG. 1. PLAN OF AREA I, SHOWING PROGRESS OF EXPERIMENT.

FIG. 2. CENTRAL PART OF AREA I IN MAY, SHOWING VACANT GROUND FROM WHICH DISEASED PLANTS HAVE BEEN REMOVED.

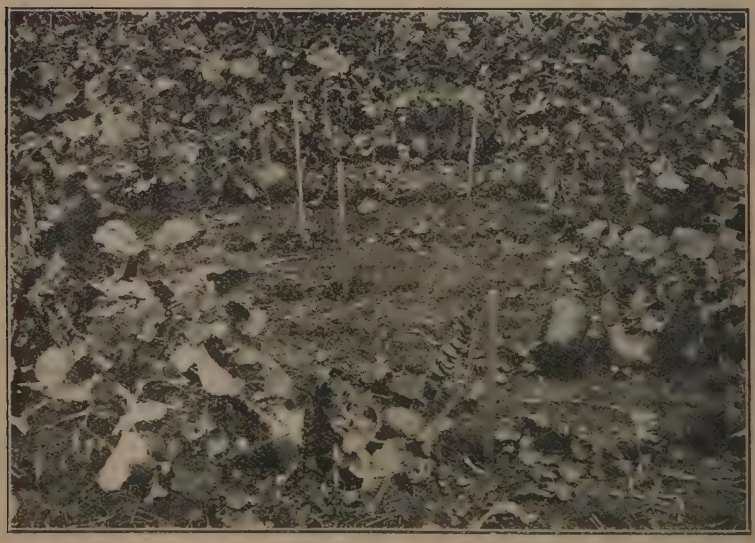


FIG. 3. TYPICAL DRY-ROT PATCH IN AREA I.
Stake in centre marks position of first diseased plant found.
[*Photos by H. Drake.*

Area 2.

A further series of treatments, using the same line of swede-seed, was sown on 8th December on land broken out of old pasture, some two miles away from Area 1. The crop was not thinned, was hand-hoed once only between the rows, and inspected twice, when no dry-rot lesions were found. On 8th May all the plants were pulled and examined. The plan (Fig. 4) shows the location of the dry-rot lesions found. At the spot marked by the large circle, in Row 24, one small bulb was almost completely rotted away and the adjoining bulb partially so. The other infected bulbs, in Row 24 and in Rows 22 and 27, showed only small lesions at old leaf scars on the neck. These almost certainly would be secondary infections caused by spores which had germinated in the axil of the leaf.

It appears, then, that in this whole block, containing 5,500 plants, only one primary centre of dry-rot infection occurred.

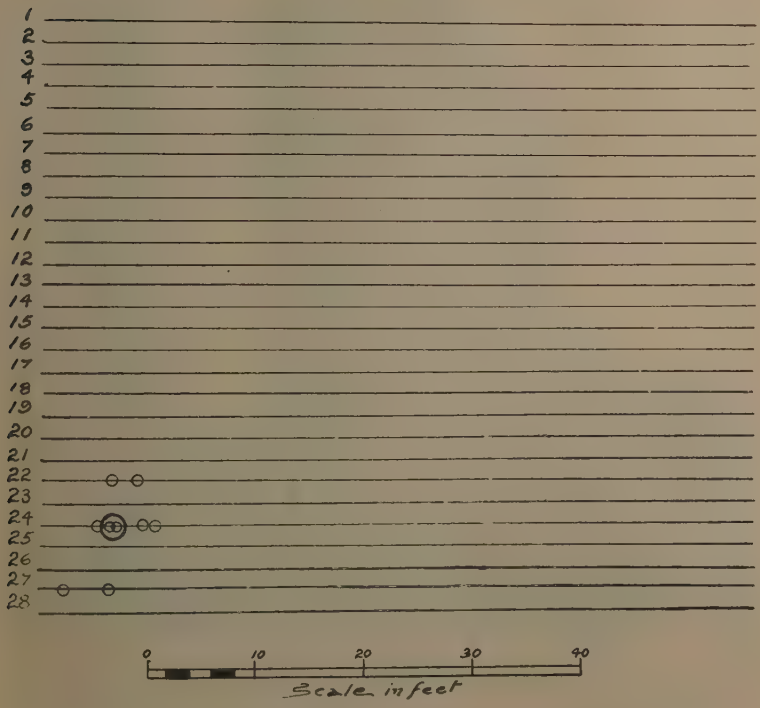


FIG. 4. PLAN OF AREA 2, SHOWING LOCATION OF DRY-ROT LESIONS FOUND.

FIG. 5. COMMON FORM OF LATE DRY-ROT INFECTION STARTING IN LEAF AXIL.
[*Photo by H. Drake.*

Seed Treatments (Area 2).

Row Nos.	Dip in 0·25 per Cent. Semesan.	Number of Plants.
1 and 2	.. 10 minutes at 155° ..	.. 0
3 ,, 4	.. 5 ,, 155° ..	.. 0
5 ,, 6	.. 10 ,, 150° ..	.. 0
7 ,, 8	.. 5 ,, 150° ..	.. 0
9 ,, 10	.. 10 ,, 145° ..	.. 0
11 ,, 12	.. 5 ,, 145° ..	.. 0
13 ,, 14	.. 5 ,, 143° ..	.. 48
15 ,, 16	.. 5 ,, 141° ..	.. 431
17 ,, 18	.. 10 ,, 139° ..	.. 179
19 ,, 20	.. 5 ,, 139° ..	.. 773
21 ,, 22	.. 5 ,, 137° ..	.. 934
23 ,, 24	.. 10 ,, 135° ..	.. 779
25 ,, 26	.. 5 ,, 135° ..	.. 1097
27 ,, 28	.. Untreated ..	.. 1275

All dipped following 1 hour presoak in 0·25 per cent. Semesan.

SUMMARY OF EXPERIMENTAL RESULTS.

(1) The treatment of swede-seed by soaking for one hour at 50° to 60° F., followed by dipping for five to ten minutes up to 135° F., both in a 0·25 per cent. solution of Semesan, did not prevent the appearance of dry-rot in the field. With the five-minutes dip, field germination was seriously affected only above 135° F.

(2) It is not practicable to free a swede crop from dry-rot by eliminating diseased plants.

(3) In an early-sown swede crop which has been well grown, and properly thinned and cultivated, dry-rot infection may spread over the entire crop before the winter from a very few original sources of infection.

(4) Late sowing, lack of thinning, and poor cultivation, with consequent poor crop of small crowded bulbs, appears to reduce greatly the incidence of dry-rot.

This confirms the observations of E. B. Levy*, and the experience of many farmers who deliberately choose the smaller yield obtained by sowing thickly after midsummer, rather than the almost certain loss of the better crop obtained by sowing earlier with better treatment.

* "Investigation of Dry-rot of Swedes: Preventive Control by Farm Management." This *Journal*, vol. 24, p. 336, June, 1922.

Maturity of early-made Cheese.—In advices received from Mr. W. M. Singleton, Director of the Dairy Division (now visiting Europe), he makes the following recommendations for improving the maturity of cheese made during August and September, also for safeguarding against soft crowns: (1) That factories install steam-heating pipes in curing-rooms to control the curing-temperature at from 65° to 68° F.; (2) that the curds be properly cooked and not oversalted in manufacture; and (3) that all cheeses be so made that each will have not less than ½ in. of air-space on the top in each compartment of the crate.

STATIONARY SPRAYING SYSTEM FOR VINEYARDS.

EXPERIENCE AT TE KAUWHATA HORTICULTURAL STATION.

T. E. RODDA, Manager, Te Kauwhata Horticultural Station, Lower Waikato.

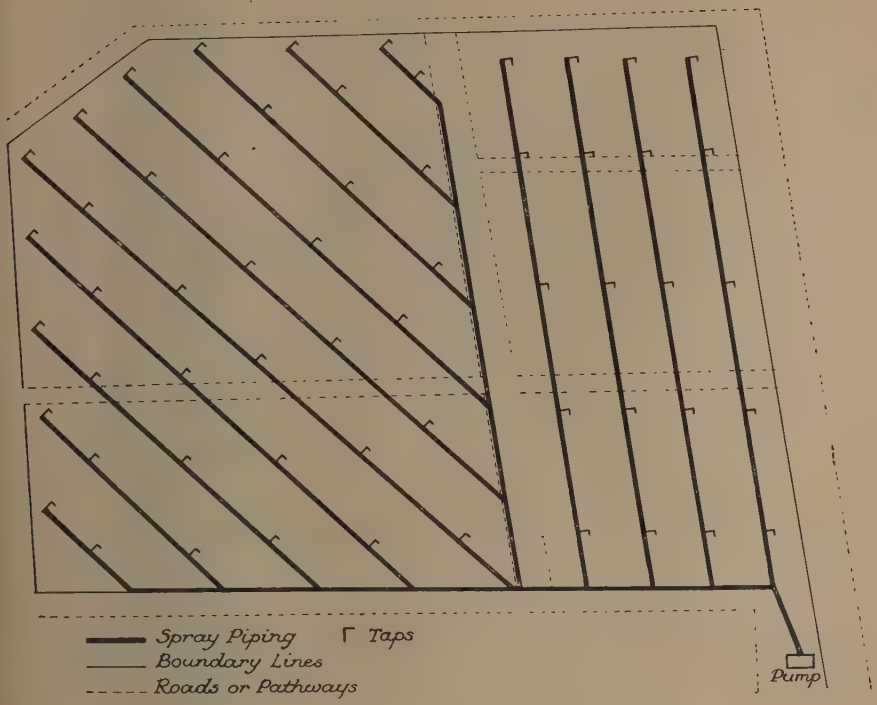
THE stationary or pipe system of spraying has become very popular in many of our New Zealand fruitgrowing districts during the last few years, having many advantages over the older method of spraying with portable outfits. The system, however, was not applied to vineyards in this country until two years ago, and the first plant appears to have been installed in the Agriculture Department's vineyard at this Station. This vineyard occupies an area of 20 acres of undulating country facing north-east, and is laid out so that the rows of vines obtain the full advantage of the sunshine.

As no information could be obtained regarding the use of such a plant in any other country the Department had no data to work on, and the plan that was eventually adopted must be considered as a partially experimental one. After a good deal of study it was considered that the most effective and cheapest way would be to lay the main pipe lines underground at the lower ends of the rows, and place the lateral lines on the tops of a number of the trellises, which are 3 ft. 6 in. high. Lateral lines were placed on every eleventh trellis, and suitable taps to connect the spray-hoses were placed on each lateral. Starting from the main line in each case, the first tap was placed at 84 ft., and the others at intervals of 168 ft. apart. Galvanized $\frac{3}{4}$ in. piping was used for all the main lines, and for an average of one-third of the length of each lateral line; $\frac{1}{2}$ in. piping was used for the remainder of the system. The accompanying plan shows the lay-out of the piping, of which a total of 9,000 ft. was used.

PUMP AND MOTIVE POWER.

During the spring of 1927 a triplex pump was installed, and it was driven by a 5 h.p. oil-engine. This combination proved thoroughly efficient, providing just sufficient pressure at 250 lb. to the square inch for four men using large nozzles. However, when electric power was reticulated through the district in the following year it was considered advisable to install an electrically driven plant. A three-cylinder pump, with a 10 in. by 48 in. air-chamber connected by silent chain drive to a 5 h.p. asbestos-protected ball-bearing motor, was chosen. This pump has a capacity of 16 gallons per minute at 500 lb. pressure.

This plant was operated for the whole of last season and gave great satisfaction, maintaining a steady pressure of 250 lb. per square inch, which I consider sufficient for vineyard spraying. Four men only were employed spraying at one time, but, judging from the volume of fluid returning to the tank, sufficient spray could have been delivered at the nozzles to keep eight men employed, provided that not more than one hose with two nozzles was attached to any one lateral line.



DIAGRAMMATIC PLAN OF PIPE SYSTEM AT TE KAUWHATA.

Provided the pump is functioning properly, there appears to be no difficulty in maintaining an efficient pressure in any section of the pipe system. Working at a gauge register of 250 lb. to the square inch, efficient pressure was obtained at the most distant point 500 yards from the pump. What the variation would be between the two points has not been tested.

HOSES AND METHOD OF OPERATING.

Hoses 120 ft. long were used for spraying. Two types were employed—a braided flexible hose of $\frac{3}{8}$ in. diameter and a seven-ply one of $\frac{1}{2}$ in. These hoses were first equipped with one nozzle for manipulation by one man, but in actual practice they were found too heavy for comfortable working. A strong Y connection was therefore fixed at the discharge end of each hose, and two 9 ft. lengths of additional hose were joined on to the double end of the Y, so as to enable two men to operate a nozzle apiece off one main lead, and thereby reducing the weight by 50 per cent. for each operator. This method answered well and did not overtax the men.

The method of operating is as follows: The hose is laid out alongside the fifth row from a lateral pipe-line, the connection end screwed on

to the first tap, and the pressure turned on. Each man picks up his lead of hose connected to the Y, opens the cock to admit the spray to the nozzle, and walks slowly up the row, spraying his side until a point half-way between the first and second taps is reached. The spray is then cut off from both nozzles, and one man grasps both spray-rods behind the turn-off cocks, while his mate walks back and seizes the hose about 12 ft. below the Y junction, and between them they give the hose a swing over into the next row. The man in charge of the nozzles then steps over the trellis after the hose and picks up both spray-rods, and with one rod in each hand starts spraying both sides as he walks down the row. Meanwhile the second operator proceeds down the row, places the remainder of the hose over the trellis, himself steps over, and returns to join his mate as he is beginning to feel some weight from the hose. Thus work proceeds until eleven rows (that is, five rows each side of the pipe-line) for the section of 168 ft. is completed. The hose is then unscrewed and transferred to the next tap on the pipe-line, and so on until the whole of the rows served by that particular pipe-line are sprayed.

The action of drawing the hoses across the trellises wears them out very rapidly, especially the braided pliable ones. The heavier types, although somewhat harder to handle, stand the strain better. All hose clips and fastenings must be of the best types and quality, to prevent blow-outs and leaks. Wiring does not give very satisfactory service.

ADVANTAGES OF STATIONARY SYSTEM.

After two years' practical experience I have come to the conclusion that on land of an undulating and heavy nature, such as at Te Kauwhata, a stationary spraying plant is 100 per cent. more effective than a portable one. Following are the reasons:—

(1) Spray can be applied when soil conditions are such as to render the use of a portable plant impossible without doubling the horse-power to pull it over wet land.

(2) The stationary system eliminates the packing of the soil that always occurs on clay land when horse-drawn outfits are used when the soil is wet or waterlogged.

(3) It enables the sprays to be applied quickly and at the correct time.

(4) It is not necessary to employ an experienced mechanic to operate an electrically-driven outfit. Ordinary labour can be used effectively on the job.

Triona Summer Oil for Spraying.—The Orchard Instructor for Hawke's Bay reports: "This oil was used by several growers during the past season, mostly at a strength of 1–80. Quite a satisfactory kill of red mite was secured at this strength. However, within four or five days young mites were becoming prevalent. I would conclude from these results that the fertility of the eggs is not destroyed, and that further applications of the oil would be necessary at intervals of perhaps fourteen days."

CONTROL OF BROWN-ROT IN STONE-FRUITS.

THE HENDERSON EXPERIMENTS WITH PEACH-TREES, 1925–29.

W. H. RICE, Orchard Instructor, Auckland.

EXPERIMENTS were instituted some years ago by the Horticulture Division, in co-operation with Dr. R. H. Makgill, at his Lincoln Road orchard, Henderson, on the control of brown-rot (*Schlerotinia cinerea*) in stone-fruits. The following notes review the results to date.

SEASON 1925–26.

The peach-orchard was divided into two blocks for preparation sprays, and treated, as the buds began to swell, with lime-sulphur, 1–15, or bordeaux, 5–4–50, respectively. Each block was again divided and received summer treatment, which gave as a test lime-sulphur versus atomic sulphur, and versus a combination of both, each on the respective base spray of lime-sulphur or bordeaux.

No variation in results in brown-rot control was found due to the base sprays, though bordeaux was found preferable to lime-sulphur as a control of leaf-curl. Bud-rot, twig-rot, and blossom-rot were modified but not fully controlled by any of the sprays applied. Satisfactory control of summer fruit-rot was secured by atomic sulphur, 8 lb. to 100 gallons. Atomic sulphur plus lime-sulphur showed a reasonable control. Lime-sulphur was not satisfactory as a control, and lowered the health tone of the trees.

SEASON 1926–27.

The base spray in this season was bordeaux, 5–4–50, over the whole area, which was then divided into three sections, each being sprayed five times—at pink and petal-fall, after three weeks, three weeks later again, and one week prior to fruit-ripening, respectively—with atomic sulphur, 10 lb. per 100 gallons, Sulpho, 10 lb. per 100 gallons, and a preparation locally known as "dry-mix."*

The results obtained showed that bud-rot, blossom-rot, and twig-rot were not fully controlled by any of the sprays applied. Varietal resistance proved to be a factor, showing little loss with Paragon, while Golden Queen suffered extensive loss. Summer fruit-rot was well controlled by all sprays. Dry-mix gave the best control, while the growth and foliage on this section was outstanding in luxuriance and general healthy tone.

* The recipe for the dry-mix spray is as follows: Take 16 lb. fine powdered sulphur, 5 lb. fresh rock lime, and ½ lb. casein. Wet the casein and dissolve it with ¼ pint of caustic-soda solution. Stir well, and bring the mixture to the consistency of milk by making it up to 1 gallon with water (caustic-soda solution is made by dissolving 1 lb. caustic soda in 1 gallon of water). Sift the sulphur and make it into a paste with water; add the gallon of dissolved casein and as much more water as is necessary to bring it to the consistency of cream. Slake the lime carefully and dilute the milk to 10 gallons with water. Strain it into the spray-tank, start the agitator working, add the "creamed" sulphur, and make the spray up to 100 gallons with water.

SEASON 1927–28.

The base spray—bordeaux, 5–4–50—was used and the summer sprays continued as in the previous season (atomic sulphur, Sulpho, and dry-mix), but on different sections of trees, in order to test out environment and usefulness under various seasonal weather conditions. A summary of the results obtained shows that brown-rot continued to manifest itself in several forms according to season, as follows:—

Bud-rot: This form takes exceptional toll of buds, and has been noted as reducing by 60 per cent. the possible crop as indicated by bud-development. This was not lessened or controlled by any of the sprays used. Varietal resistance proved the main factor.

Blossom-rot: Flower-infection resulted in the loss of up to 20 per cent. of the blooms according to variety, and was not amenable to any sprays used.

Twig-rot: Many fruiting laterals are affected by this form, though the main loss is of soft young growth. It was uninfluenced by any spray used. Varietal resistance proved to be a factor, though a more readily controllable factor is density of tree. Pruning should aim at opening up and spacing trees prone to bushy habits.

Fruit-rot: This may develop at any stage of growth, but unless under a damp atmosphere does not normally show up until the fruit is nearing picking-maturity. A table showing the rainfall for the period of fruit-development will be found at the end of this article, and discloses a rather large number of days on which rain fell. Without summer sulphur sprays the district average loss of crop due to this form is estimated at 40 per cent. With all the forms of sulphur used good results were obtained, and the infection reduced to ½ per cent. in the case of dry-mix, while in no instance did the loss exceed 7 per cent. All sprays used had a beneficial effect on the general health of the trees, giving robustness of growth and foliage.

SEASON 1928–29.

Further investigations being advisable with a view to reducing bud-, flower-, and twig-rot, the experiment was conducted on a base of late autumn bordeaux, 8–6–40, applied in June to half the block, and bud-movement bordeaux, 5–4–50, to the other half. These sprays proved to have no influence on brown-rot control, but both proved equally effective in the control of peach leaf-curl.

Pruning: The usual form of pruning, which is on a long-short principle (with every lateral and leader tipped either long or short), was modified on half the area, including all varieties to the extent of leaving laterals untipped, though in each instance the leader was shortened and surplus laterals cut out. Checks showed that bud-, blossom-, and twig-rot were rather more prevalent on the untipped laterals than on those tipped. This type of pruning, from a wood-renewal standpoint, is not to be recommended for Paragon, while with other varieties little was gained, except with Carmen, which responded well, though in all varieties the highest-quality fruit was carried by tipped laterals.

Early sulphur spray: One line of trees of mixed varieties received an additional spray with dry-mix at the burst of bud. These showed

to no advantage alongside others not so treated, and this confirms other observations that sulphur works best during the warmer weather.

Summer sprays: Four applications of dry-mix were made respectively over the whole area, at pink, three weeks later, fruit half-grown, and one week prior to ripening, thus reducing the number of summer sprays by one as compared with previous seasons, when this mixture had given satisfaction. Good control of fruit-rot was attained, the loss being negligible.

Bud-, flower-, and twig-rot were less prevalent this season than for some years past. This lesser infection cannot be attributed to any special precautionary spray, as observations showed it to be constant over all sections. Conclusions are that the strict sanitation practised in this orchard has a decided influence for good. No infected fruit is allowed to remain on the trees or to come into contact with other fruit in the picking-containers. All infected fruit is properly destroyed. During pruning all diseased or doubtful wood is removed and destroyed, even small twigs not being allowed to remain on the ground or to be turned under.

GENERAL.

A review of the four seasons' experiments shows that brown-rot in peaches can be controlled by strict orchard sanitation and the application of dry-mix sulphur during summer. Some loss is experienced from the early-season forms of brown-rot, which are not so amenable to treatment, but the more devastating fruit-rot form is reduced to a negligible point.

The programme recommended for a season's peach-spraying is as follows:—

At bud-movement: Bordeaux, 5–4–50; followed immediately by oil, 1–17, as an insecticide.
At pink stage: Dry-mix, 16 lb. to 100 gallons; followed three weeks later by dry-mix, 16 lb. to 100 gallons.
At fruit half-grown stage: Dry-mix, 16 lb. to 100 gallons.
One week prior to fruit ripening: Dry-mix, 16 lb. to 100 gallons.

A feature of the sulphur spray is that the foliage is retained in such good order and capable of building up the tree after the crop is removed. The general improvement of the orchard is indicated by the accompanying table of crop returns over a period of years, which, while disclosing

Crop Returns—Paragon Variety.

Season.	Number of Trees.	Number of Marketable Cases.	Average per Tree in Half-bushel cases.
1920	160	444	$2\frac{3}{4}$
1921	160	78	$\frac{1}{2}$
1922	160	639	4
1923	160	730	$4\frac{1}{2}$
1924	160	254	$1\frac{1}{2}$
1925	150	953	$6\frac{1}{3}$
1926	150	562	$3\frac{3}{4}$
1927	147	1,010	$6\frac{4}{5}$
1928	147	429	3
1929	147	987	$6\frac{1}{2}$

an alternate crop variation, shows a decided improvement on returns obtained previously. The variety Paragon was selected for this table as the trees have been of mature stature for the whole period, and for the further reason that they are the principal variety grown in the Henderson district.

The trees used as a groundwork for the tests were of the varieties Paragon, Carmen, J. H. Hale, Hay's Cling, Golden Queen, Ideal, Wallace's Best, Yates Cling, Alton, and Delicious.

Rainfall at Location of Orchard during Period of Fruit-development.

Season.	December.		January.		February.		March.	
	Amount.	Days.	Amount.	Days.	Amount.	Days.	Amount.	Days.
	Inches.		Inches.		Inches.		Inches.	
1925–26	1·78	19	5·64	18	3·15	19	3·41	13
1926–27	8·38	21	1·30	14	4·71	15	5·53	20
1927–28	1·32	18	0·17	5	2·12	10	4·42	18
1928–29	5·20	20	1·88	17	0·28	8	5·89	22

The writer desires to record thanks due to Dr. R. H. Makgill for his hearty co-operation in these tests, and to Mr. A. Schramm, orchard manager, for so carefully conducting the work.

WEEDS AND THEIR IDENTIFICATION.

BLACK NIGHTSHADE *(SOLANUM NIGRUM* L.*)*.

Esmond Atkinson, Department of Agriculture, Wellington.

Black nightshade belongs to the same family as the potato and tomato (Solanaceae), which consists of about fifteen hundred species and is most largely developed in the tropics, though it is found in many temperate regions also. The genus *Solanum*, containing roughly twelve hundred species, is one of the largest known, and includes small trees, shrubs, climbing-plants, and herbs. It is most plentiful in South America.

Black nightshade is an annual, with a bushy branching habit that gives it the appearance of a small shrub. It is, moreover, often woody at the base. In the open it is 1 ft. or so high and more or less rounded and compact. A certain amount of shade does not kill it, though it changes its appearance so much that it is then often hard to recognize as the same plant.

The leaves are placed singly on the stem or in clusters, and a very common shape is that shown in the figure, though forms occur often enough in which they are strongly toothed or even lobed. They are thin in texture with well-marked veins, but this character varies very

BLACK NIGHTSHADE, NATURAL SIZE.

[*Drawing by Esmond Atkinson.*

much according to where the plant is growing. In the shade the leaves and stems are pale green, but in the open quite often strongly tinged with blackish-purple.

The stems are angular in section and generally roughened at the angles. The figure shows the shape and arrangement of the flowers and fruit. The flowers are white with a cluster of five yellow anthers round the style and stigma, while the fruit becomes, when ripe, jet black, shining, and juicy.

POSITION AS A WEED.

Black nightshade is often spoken of as one of the most widely distributed plants in the world, and is found in nearly all subtropical and temperate countries in both hemispheres. In New Zealand it occurs in abundance as far south as Central Otago, from sea-level to 2,000 ft., and is, moreover, spreading in some districts. There is evidence that in this country there are two species which have been confused—the introduced weed and a little-known native plant. In an article in the "Natural History of Canterbury" that includes a list of native plants with the communities to which they belong, Dr. L. Cockayne, F.R.S., says: "Forest, but not in the primitive community (the New Zealand plant probably is an unnamed endemic species, and *S. nigrum* L. is an introduced species)." The differences between the two plants, however, are small and of a technical nature, and the one that concerns readers of the *Journal* is the black nightshade, which is a weed of gardens, roadsides, and waste places generally, and—more recently—in some districts, of thin pastures (Hilgendorf, "Weeds of New Zealand," page 152).

The following passage in Mr. E. Bruce Levy's "Grasslands of New Zealand," page 101 (though black nightshade is only one among a number of weeds there mentioned) is quoted here in full, as the information it contains is very much to the point in dealing with the present plant and others closely related as weeds: "Most of our weeds of arable land are annuals which establish in the early warm weather of spring. Many such annuals—namely, summer annuals—establish only in the spring, and among the more common ones may be mentioned fat-hen, smartweed, wireweed, black nightshade, purslane, bindweed, &c. If the pasture mixture be spring-sown on land infested with seed of these weeds they become powerful competitors, whereas if the pasture is autumn-sown there is no danger from them whatever. If these weeds germinate at all in the autumn they never become well-established vigorous plants."

Black nightshade is fairly often spoken of as a poisonous plant—though the evidence is conflicting, as jam has been made of the berries—and the name "deadly nightshade" has been given to it. The true deadly nightshade (*Atropa belladonna* L.), which is quite a different plant, belonging to the same family as black nightshade but not closely related to it, *is* extremely poisonous, and contains the alkaloid atropin, which is used in medicine. A few scattered plants of *Atropa belladonna* have been found naturalized in New Zealand, but fortunately it does not seem to have spread. Those who think that popular plant-names are accurate enough for the practical man have here an example of their not proving altogether adequate.

PHOSPHATE TOP-DRESSING OF HILL GRASSLAND.

MANAWATU FARMER'S RECORDED RESULTS.

Fields Division.

THE trial described in these notes was commenced in the winter of 1928 on the property of Mr. A. K. Greves, Aokautere, near Palmerston North, in co-operation with the Department of Agriculture. The farm is situated at an elevation of approximately 1,200 ft. to 1,500 ft. above sea-level. Its total area is 400 acres, of which 350 were used in the trial. The remainder consists of bush and two small paddocks under cultivation.

The pastures prior to top-dressing consisted of cocksfoot, crested dogstail, and a little rye-grass and white clover, together with a good deal of catsear and rib-grass. An area of 150 acres was top-dressed with about 3 cwt. of superphosphate per acre during July. Of this area a paddock of 79 acres had been top-dressed in the winter of 1925, but so far as could be observed the effect of the manure in 1928 was negligible. An area of 200 acres was used as a control for the trial.

It was impossible to predetermine the exact relative carrying-capacities of the two areas, so each was stocked with ewes plus a few dry sheep, at what was considered to be their probable respective capacities, the top-dressed area at the rate of 2 sheep and the control area at 1¼ sheep per acre. The use of cattle on this country is highly advantageous, and beasts were grazed on both areas as shown in the tabulated statement. The cattle-grazing commenced on 15th September, and on the 31st March, 1929, the cattle were still on the top-dressed area.

A marked stimulation of white clover occurred as a result of the top-dressing, and the growth of rye-grass was noticeably improved.

All sheep were shorn by Mr. Greves, who reported as follows: "The ewes from the top-dressed area were in good condition and shore easily, with only an occasional gummy fleece. The ewes from the non-top-dressed area were not in such good condition, and on an average their fleeces were very gummy." The wool from each lot was kept separate and valued by a disinterested person who knew nothing of the history of the trial. He remarked regarding the wool from the sheep off the top-dressed area that it was "Brighter, better grown, and with very few cotts"; whereas he described the wool from the non-top-dressed area as "harsher feeling, with more cotted fleeces, and not such a good colour." The weights of wool produced and prices realized were as follows: From top-dressed area, average 8 lb. per fleece, and 16d. per pound realized; from non-top-dressed area, 7·8 lb. fleece, and 15½d. per pound realized.

Referring to the shearing of the lambs, Mr. Greves states that in the case of those from the top-dressed area the comb of the shearing-machine required cleaning after every eight or nine lambs, whereas it had to be scraped after every three or four lambs when shearing those from the non-top-dressed area.

Statement of Accounts: A. K. Greves, Aokautere.

Top-dressed Area, 150 Acres. Stocked at 2 Ewes per Acre.						Non-top-dressed Area, 200 Acres. Stocked at 1¾ Ewes per Acre.					
Date.	Revenue Items.	Number.	Rate.	Weeks.	Receipts.	Date.	Revenue Items.	Number.	Rate.	Weeks.	Receipts.
			s. d.		£ s. d.				s. d.		£ s. d.
Jan. 4	Fat lambs	47	..	..	53 15 7	Jan. 2	Fat lambs	26	..	..	28 10 2
Jan. 26	,, ...	36	..	..	34 3 0	Jan. 14	Store lambs	100	17 6	..	87 10 0
Jan. 25	Wool	..	..	..	130 11 9	Mar. 25	Wool	..	..	..	102 9 3
Mar. 20	,, ...	..	..	..	37 12 4	Mar. 20	,, ...	..	..	..	31 4 2
	Grazing—						Grazing—				
	Bullocks	59	1 6	4	17 14 0		Bullocks	35	1 6	4⅔	11 5 0
	,, ...	35	1 6	8	21 0 0		Cows and Heifers* ..	22	1 0	31	34 2 0
	Cows and Heifers* ..	22	1 0	6⅔	6 18 3	Jan. 14	Ewe lambs to top-dressed area	69	23 0	..	79 7 0
Mar. 31	Ewes on hand	111	27 0	..	149 17 0						
Mar. 31	Wethers on hand.. ..	92	20 0	..	92 0 0	Jan. 15	Wether lambs to top-dressed area	40	13 2	..	26 6 8
Mar. 31	Increased value of lambs transferred from non-top-dressed area—										
	Ewes	69	4 0	..	13 16 0						
	Wethers	40	6 10	..	13 13 4						
					571 1 3						
	Less cost of top-dressing ..				144 6 0						
	Net total ..				426 15 3		Total ..				400 14 3

* 17 heifers and 5 dry cows.

The returns per acre from the top-dressed area amount to £2 16s. 3⅓d. on this basis, while from the non-top-dressed area they are £2 0s. 0¼d., giving a balance of 16s. 3d. per acre in favour of the top-dressed land.

Two small drafts of fat lambs (as shown in the table) were taken off the top-dressed area, and only one from the non-top-dressed area.

Mr. Greves's records of the cost of top-dressing are as follows :—

	£	s.	d.
22 tons super (44/46 per cent.) at £5 per ton	110	0	0
Cartage from rail to farm, 10s. per ton	11	0	0
Sowing—136 hours at 2s. per hour	13	12	0
Sledging—One man and two horses for 48½ hours, at 4s. per hour ..	9	14	0
	£144	6	0

Cost of manure and application per acre = 19s. 3d.
Cost of application of manure from roadside = 3s. 1½d.
Average number of acres top-dressed per man per eight-hour day = 8·8.

The accompanying table has been arranged from returns presented by Mr. Greves. The increase in value given to lambs transferred from the non-top-dressed to the top-dressed area for the period of ten weeks may not be fully justified. However, this does not make any appreciable difference to the increase in return. The effect from the top-dressing will continue for another year at least, even though in diminishing amount, so that the statement does not reveal the whole of the benefits derived from the fertilizer.

A further objective of this trial is to maintain the country already top-dressed, and each year bring a further portion under treatment, increasing the stock each year by holding sufficient ewe lambs for replacement and a reasonable increase as well.

The Division is indebted to Mr. Greves for the care taken with the management and records of the farm in connection with the trial.

Temporary Sterility of Dairy Cows.—Dealing with sterility in an article published in the *North American Veterinarian* for May last, Nils Lagerof, a Swedish investigator who recently visited Denmark, Germany, Switzerland, and Holland, states that in those countries treatment is carried out according to the methods of Albrechten and Hess—methods with which we are quite familiar in New Zealand. In short, they consist of manipulation of the ovaries and a specialized method of irrigating the uterus. Both methods give excellent results in cases where there are well-defined disease conditions; but, unfortunately, do not appear to give equal results in the temporary form of sterility, which constitutes by far the greatest number of cases under investigation. Temporary sterility appears to be a functional sterility, and noticeable disease conditions of any importance are conspicuous by their absence. Following this line considerable investigational work is on hand in New Zealand with the use of calcium by various methods, mineral supplements, and the use of the fairly recently discovered vitamin E—work which should offer a far more promising field.—*Live-stock Division.*

Interim Returns of Live-stock.—Approximate figures for 1929 include the following (the final figures for 1928 being added in parentheses) :—Horses, 299,120 (307,160); dairy cows, 1,370,779 (1,352,398); total cattle, including dairy cows, 3,444,191 (3,273,769); number of sheep shorn, 1928–29 season, 25,290,878 (23,958,577); number of lambs tailed, 1928–29 season, 13,853,087 (13,178,972); total sheep—including lambs, 29,011,447 (27,133,810); pigs, 556,795 (586,898). Details of the interim sheep return were published in last month's *Journal.*

MOULDS IN UNSALTED BUTTER.

RESEARCH AT WALLACEVILLE LABORATORY.

G. F. V. MORGAN, N.D.A., N.D.D., Dairy Division, Wallaceville Laboratory.

(Continued.)

FUSARIUM LACTIS.

Direct contamination by this mould in the butter-factory was hard to trace. There can be little doubt that its long rod-shaped spores are in circulation in the factory atmosphere, though only occasionally have they been isolated by factory-atmosphere exposures on artificial media. Growths of the mould are, however, to be found frequently on the woodwork of freezing-vats into which the cream is run after pasteurization. The typical red discoloration may be seen through the white paint on most of the older types of vat. This colour changes to purple or violet if there is a slight leakage of ammonia in the neighbourhood of its growth, or any percolation of ammonial fluid through the woodwork in these parts.

Spore-formation.—The spores of this mould are not nearly so numerous as in a number of others, and are produced in small bundles in scanty patches on the mycelium. The spores themselves grow in small bundles or singly at the end of very short hyphal cells. This head formation is very difficult to find under the microscope, as by the time any part of the mycelial growth has reached the slide for examination the spores have usually become detached. Moulds of this type are particularly difficult to stain, as in the presence of moisture there is a tendency to disintegrate into component cells. For staining purposes it is best to use glycerine with an alcoholic solution of carbol fuchsin. Examination of stained spores under the $\frac{1}{12}$ lens of the microscope shows the outer and inner cells of the spore quite clearly.

Mycelial Growth and Pigmentation.—The mycelium of this mould produces a close, much-branched growth in the butter in which it may be growing. Fine cross-sections of butter showing the typical red discoloration were cut after freezing on the microtome, and revealed the curious pigmentation produced by a mould of the *Fusarium* species. The cross-section revealed a very reticulated mass of mycelial hyphæ, which appeared to contain little pigment. At irregular intervals there were patches of deep red pigment apparently outside the body of the hyphæ. These patches of colour did not seem to have any connection with the formation of spores by the mould. Further cross-sections were cut and pressed on to the slide under a thin cover glass and then examined under the $\frac{1}{12}$ lens. The patches of pigment remained in irregular masses, some of which appeared quite detached from any mycelial cell. Photographs were subsequently taken of some of these patches of colour that had become partially dispersed, and would seem to indicate that a number of very fine rod-shaped organisms were present. After several washings of butter showing this red discoloration had been made with alcohol a

FIG. 6. CULTURE OF FUSARIUM LACTIS ON ARTIFICIAL MEDIUM.

FIG. 7. PHOTOMICROGRAPH OF FUSARIUM MYCELIAL GROWTH AND SPORES OF FUSARIUM LACTIS. ($\frac{1}{12}$ LENS.)

[Photos by G. F. V. Morgan.

large number of the small red masses were found in suspension in the alcohol, intact and separated from any other portion of the mould.

As distinct from the pigment produced by any of the other common butter-moulds, the pigment of the fusaria appears to be diffused through the body of the fat. It will be found that if the fat in discoloured portions of butter in which the fusaria are growing is extracted with ether or alcohol, the colour remains in the fat when it has been washed quite free from the mycelium of the mould. Pigmentation does not occur entirely outside the hyphal cells, for examination under the $\frac{1}{12}$ lens will show the presence of granules of colour in the body of the cells themselves, though these are not nearly so frequent or so large as the patches of red pigment lying outside. The red pigment produced by this mould is also capable of acting as an indicator for alkaline or acid conditions, as in the case of its presence under alkaline conditions the colour changes in a few seconds from red to violet or purple. This colour-change may frequently be noticed in old cultures of the mould, in butters in which large numbers of putrefactive bacteria producing alkali are present, or in which this mould, which produces an alkaline condition itself, is in an advanced stage of growth. Under these circumstances the colour produced by the mould is a deep purple or violet instead of red. This frequently occurs, and the presence of another type of mould is often suspected. Further investigation on the chemical composition of this pigment is being carried out.

The rate of mycelial growth in butter is very rapid, and this would cause a tendency to spread deeper into the texture of the butter than the other moulds; also a very luxuriant growth of aerial mycelia is usually produced, forming a white felted mass over the surface of the butter. This contains very little pigment, whereas the butter containing the lower portions of the mycelial growth may be a deep red. Artificial media in which this mould may be growing frequently show bright red spots in their substance before any appreciable growth of mycelium can be seen under the microscope; the same deep-red spots may be noticed as in butter. Spores are capable of germination on the outside of butter-paper and of growing through the texture of the paper into the butter.

The thermal death-point of fusaria is hard to determine, for the same reasons that apply to the other moulds. In the case of fusaria, however, no germination has been seen on any plate from cultures heated higher than 60° C.

Resistance to Brine Solutions.—The resistance of the spores of this mould to brine solutions is slightly greater than that of the *Stemphylium* type, in so far as they are capable of germination in media containing 8 per cent. solutions of salt, though no germination is obtained in over 7 per cent. brine in the case of the latter.

The spores of *Fusarium lactis* have been found to lose their vitality very quickly in water, no growth having been obtained from spores that had remained in water for more than three days.

Effects on Dairy-produce.—Fusarium moulds produce rapid alkalinity in the breakdown of protein matter, with the production of gas. Lactose is not fermented, but can be used in its metabolism. This mould can remain virile in butter for three months at cold-storage

temperature, but takes longer to germinate after defrosting than the *Stemphylia*, *Penicillia*, and *Oidium lactis*, which are all capable of germinating ten days after defrosting. Moulds of the *Fusarium* type require frequently four to six weeks before they make their appearance.

Anaerobic Growth.—No cultures have yet been obtained from spores of this mould in butter or on artificial media under complete anaerobic conditions, incubated at 20° C.

PENICILLIUM GLAUCUM.

Contamination of cream and butters by the *Penicillium* type of mould is perhaps more common than by most of the other five moulds under review, and it may be considered as common a contamination as is that of *Oidium lactis* in dairy-produce. The spores of *Penicillium glaucum* are common everywhere, but in the butter-factories they appear to be found in and to prefer the drier parts of a factory building, such as the box-room and the rooms where salt and butter parchment are kept. It must be realized that no hard or fast line can be drawn for definite sources of contamination, as mould-spores of different varieties are to be found circulating in the atmosphere of the butter-room itself, which is perhaps the dampest place in any butter-factory. The spores of this mould very frequently settle on butter-parchment and remain virile under very dry conditions for a considerable time. This contamination of the paper in which butter is wrapped is a very frequent source of mould trouble in unsalted butters, and will be referred to later on. Though perhaps dry conditions may not be in any way considered as ideal for the growth of *Penicillia*, the spores certainly seem to remain virile under dry conditions longer than those of other moulds. Butter-box wood is also a frequent cause of contamination.

Spore-formation.—The spores of *Penicillia* are formed at the end of specialized erect hyphæ, which branch and form two parallel short hyphal cells, which in their turn branch again. At the end of these cells round spores are produced, which in the case of dense colonies may amount to seven or eight in number at the end of each terminal cell. When the conidiophore of *Penicillia* is growing horizontally over the surface of a liquid medium, as many as fifty spores have been counted on the terminal hyphæ. When the spores of moulds of the *Penicillium* type germinate the outer coat of the spore swells, but no abstriction occurs as in the budding process of yeast. The inner jacket of the spores swells and finally ruptures the outer jacket, from which the pro-mycelium projects ; a double rupture of the outer spore frequently occurs with a double pro-mycelial growth. Mycelial growth in these cases takes place from both sides of the original spore. The spores of the *Penicillia* are round and smooth, and similar in shape to those of the *Aspergilli*. Young *Penicillium* spores may germinate in under twenty-four hours ; spores of old cultures kept under dry conditions may take a week or even longer.

Mycelial Growth and Pigmentation.—The mycelial growth of *Penicillium glaucum* in butter seems less compact and more straggling than that of other butter-moulds. Its development seems to become concentrated about certain points ; at these points a deeper pigmentation occurs, and if the butter is uncovered clusters of conidiophores will appear. This gives an impression of unequal colour-production, and

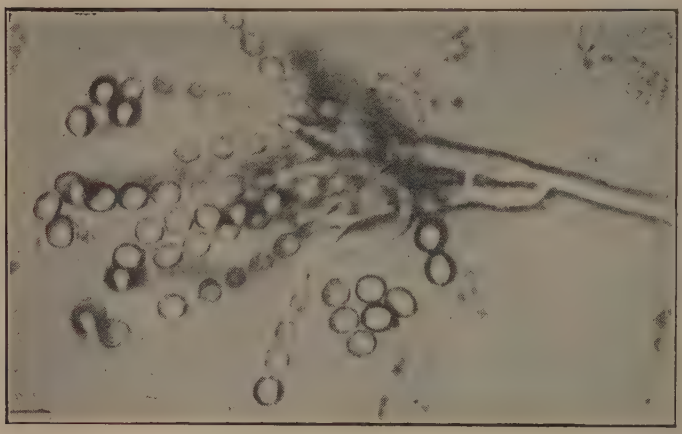


FIG. 8. PHOTOMICROGRAPH OF HEAD OF PENICILLIUM GLAUCUM, SHOWING SPORE FORMATION. ($\frac{1}{12}$ LENS.)

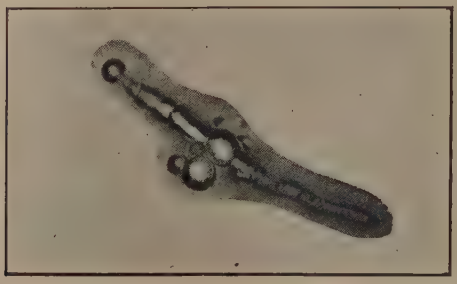


FIG. 9. PHOTOMICROGRAPH OF SPORE OF PENICILLIUM GLAUCUM. ($\frac{1}{12}$ LENS.)
[*Photos by G. F. V. Morgan.*

a more mottled appearance to butter discoloured by the mould. The colour produced in the tissue of the mycelium and conidiophores is a characteristic blue-green, which is particularly pronounced in the conidiophore of the mould. Pigmentation may be clearly seen in the older and coarser growths of the mycelium; the colour that is imparted to the butter, however, is a bright yellow, and not usually the blue-green of the mould pigment. The pigment of the *Penicillia* similar to that of the *Fusaria* seems to become disseminated through the body of the butter in the neighbourhood of the mould development, but this, unlike with the *Fusaria*, never seems to happen on artificial media. In the early stages of *Penicillium* growth in butter the bright-yellow discoloration only may be noticeable. This may also be the case in unsalted butter from the butter-box, where it has been closely covered and an aerial mycelium has not been able to appear. It is safe to suspect the

presence of *Penicillium* mould in any butter showing a yellow discoloration. Mycelial growth is in most cases much shallower than with other butter-moulds, and discoloration does not seem to penetrate very far into the body of the butter.

The thermal death-point of *Penicillium glaucum* seems, from an average of forty cultures, to be slightly higher than that of other butter-moulds. Spores have frequently germinated after reaching the temperature of 75° C. Cultures have also developed from spores that have reached 90° C., but these have been isolated cases.

Resistance to Brine Solutions and Disinfectants.—Spores of *Penicillium glaucum* can germinate in media containing 7 per cent. of salt. Germination in media containing 8 per cent. has rarely occurred.

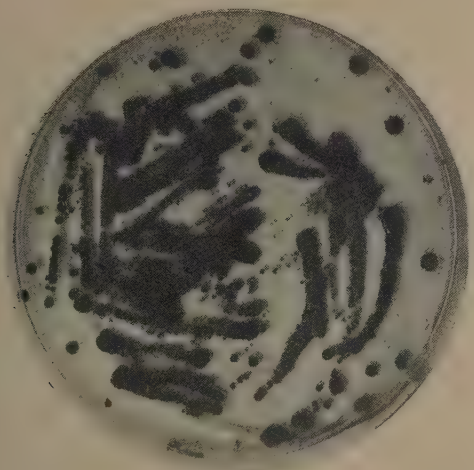


FIG. 10. SHOWING GROWTH OF PENICILLIUM GLAUCUM ON SOLID MEDIUM.
[*Photo by G. F. V. Morgan.*

This mould will germinate after remaining in 5 per cent. formalin for ten minutes, but not in a higher percentage. Spores of *Penicillium glaucum* are capable of remaining virile in tap water for four months, and have been isolated from dry salt in which they must have remained virile for more than one month.

Biochemical Features and Effect on Dairy-produce.—*Penicillium glaucum* differs from all the other five common butter-moulds in the important fact that it produces acidity and no liquefaction of protein matter, whereas all the others produce an alkaline reaction with the breakdown of protein and the production of gas. *Penicillia* would appear to ferment lactose and so produce lactic acid. If colonies of this mould are grown on litmus lactose agar marked acidity will be noticed in the neighbourhood of their growth. *Penicillium glaucum* is also capable of growth and development in milk, and in litmus milk

will produce marked acidity and quick curd-formation. Growth on nutrient gelatine showed no liquefaction in two weeks. A distinct earthy flavour is produced in butter.

Anaerobic Growth.—Scanty growths of *Penicillium glaucum* have been obtained in eight days under complete anaerobic conditions on artificial media incubated at 20° C.

Behaviour under Cold-storage Conditions.—*Penicillium glaucum* will germinate in unsalted butter after remaining in store for three months at an average temperature of 5° C., but will not germinate in cold storage itself, only germinating when two weeks have elapsed after defrosting. Control samples germinated in one week at ice-box temperature—about 10° C.

OIDIUM LACTIS.

Contamination of dairy-produce by *Oidium lactis* is fairy general. Spores and fractions of mycelium are to be found in the cream, and may often be found in samples of milk shortly after it has left the cow. The spores are to be found in all parts of the factory, though growth on walls or woodwork is not frequently noticed. Spores are occasionally found on butter-parchment and in factory water-supplies.

Reproduction.—Spores of the type discussed in connection with the other moulds are not formed in the *Oidia*. Their reproduction is somewhat similar to that of mycelium-forming yeasts, the only apparent difference being that the *Oidia* are capable of forming dry aerial mycelium. No conidiophores are formed, but reproduction takes place by budding of specialized portions of the mycelium; branching also takes place in these parts. The budding parts referred to, when examined under the microscope, resemble the formation of chains of short hyphal cells. These cells break off and germinate in the same way as the ordinary mould-spore, forming a rudimentary pro-mycelium. The aerial mycelium forms a dense matted surface growth, white in colour, growing almost ½ in. above the surface of the medium in which the mould is growing. In butter a comparatively short aerial mycelium is formed. To examine the reproductive parts of this mould staining with carbol fuchsin and glycerine will be found practicable, and an examination can be made under the oil immersion lens.

Mycelial Growth and Pigmentation.—The mycelial growth of this mould shows the development of long mycelial strands becoming intertwined in a rope formation, rather than the reticulated branching development characteristic of the other butter-moulds. The mycelia does not produce pigment either in its aerial growth or in the body of the medium in which it may be growing. In very old cultures of *Oidium lactis* in butter a brown discoloration may be noticed in the neighbourhood of its growth, but this seems to be due to the action of the mould and its by-products rather than a production of pigment by the mould itself.

Thermal Death-point.—This is less than that of the other moulds, few cultures germinating after treatment at a higher temperature than 55° C., and very few at or after 60° C.

Resistance to Brine Solutions.—*Oidium lactis* shows less power to germinate in a salt medium than any of the other moulds, no germination having been obtained in the presence of more than 4 per

cent. of salt. The resistance to salt itself seems to compare favourably with that of other moulds, as the spores of *Oidium lactis* are capable of remaining virile in fairly high salt solutions for three or four months, though the spores will not germinate in the butter itself or in a medium of equivalent saline strength.

Resistance to Disinfectants.—Results of culturing after treatment with formalin were uncertain, and nothing definite was obtained. Spores of this mould were capable of remaining virile in water for more than four months.

Biochemical Reactions.—*Oidium lactis* causes a breakdown of protein, with production of alkalinity and gas. This occurs rapidly in dairy-produce, and fairly rapidly in media containing a large percentage

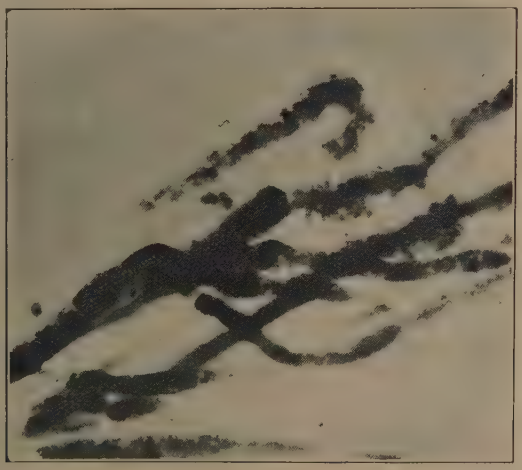


FIG. 11. PHOTOMICROGRAPH SHOWING COMMENCEMENT OF BUDDING PORTION OF OIDIUM LACTIS. ($\frac{1}{12}$ LENS.)

[*Photo by G. F. V. Morgan.*

of protein matter. Flavour produced is rather similar to that produced by certain dairy yeasts, and is typical of certain types of soft cheese, such as Pont l'Évêque, which are partially ripened by this type of mould.

Anaerobic Growth.—No growth has yet been obtained at Wallaceville under strictly anaerobic conditions, with incubation at 20° C.

Behaviour under Cold-storage Conditions.—*Oidium lactis* will not germinate in cold store at 5° C. in three months, but its spores will remain virile during that time, will germinate, and the mould will make its appearance in two weeks after defrosting. Mould will germinate in one week at ice-box temperature—about 10° C.

(To be concluded.)

METALS FOR DAIRY MACHINERY.

Report to the Dairy Research Management Committee by F. H. McDowall, D.Sc., Dairy Research Institute, Palmerston North.

The problem of finding a satisfactory metal for use in the fabrication of dairy machinery has two aspects, which are often, but not always, complementary.

(*a*) *Milk should not have a deleterious effect on the metal.* It is desirable that dairy machinery should be made of a material that will not corrode or suffer other damage under any of the conditions of treatment to which it is subjected. It should not dissolve or stain in contact with milk, it should be sufficiently strong for its purpose, it should be a good conductor of heat, and it should be reasonably easily worked into the shapes required. So far as this aspect of the problem is concerned, the choice of material for any piece of equipment depends solely on economic circumstances. Replacements of corroded vats, coolers, buckets, and cans form a very considerable proportion of the annual expense of a dairyman or a dairy company, and much inconvenience can result if these replacements become necessary at the flush period of the dairying season. The progressive dairy company will choose the cheapest of the materials that give satisfaction, it being, of course, understood that the estimation is taken over a period of years covering the life of the machinery made of the metals under consideration.

(*b*) *The metals should have no effect on milk or its products.* In many phases of science the developments during the present century have been in the direction of discovering the effect exerted by small quantities of chemical substances. The effect of vitamins, in the science of nutrition, and the influence of small amounts of iodine in the soil in which foodstuffs are grown on the incidence of goitre, in the science of pathology, are well-known instances. Such developments have effected a notable change in the sciences, and have contributed largely to their progress. Of the discoveries made along these lines in the science of dairying, probably the most important is the effect of small quantities of dissolved metals on the quality of milk-products. It was shown by Golding and Teilman (Journ. Soc. Chem. Ind., 1905, 5, 24) that small amounts of copper can cause off-flavours in market milk. Rogers, Berg, Potteiger, and Davis (U.S. Dept. of Agr., B.A. I, Bull. 162, 1913) showed that fishy and tallowy flavours in butter can arise through the presence of minute amounts of copper. These findings have since been confirmed by many workers, and recently by Davies (*Industrial Chemist*, 1928, 269), who claims that as small a proportion of copper as one part per million in butter can cause fishiness and tallowness. While such is probably not the case for all conditions of manufacture of the butter, it is a fact of very great importance to the dairy industry. It has been shown, too, that rusty cans are often responsible for a metallic flavour in butter, and in milk for marketing purposes; and Mattick has recently demonstrated that oiliness in milk can result from the use of a cooler of tinned copper from which the tinning had been partly worn away. The effect of small quantities of metallic salts in dairy-products has a special significance for the dairy industry in New Zealand, since the faults engendered by their presence are for the most part evident only after storage for some time.

The present report embodies the result of observations and inquiries made during a recent visit to dairies and dairying institutions in Europe and in the United States of America. Some of the metals are now under test at the Dairy Research Institute, but this report should be regarded,

for the most part, as the conclusions of the author drawn from the publications available on the subject and from the information gathered in the countries visited. Unfortunately the information obtained in different places was often quite contradictory. In Chicago, for example, a company engaged solely in the manufacture of nickel machinery offered the opinion that the metal was quite unsuitable for dairy equipment. They had formed this opinion after several tests under practical conditions in dairy factories. In the same city a visit was paid to a large dairy where the equipment was almost completely of nickel, which, though not perfectly satisfactory, was claimed to be better than tinned copper.

Hunziker (World's Dairy Congress, 1923 and 1928) and Seligman (World's Dairy Congress, 1923) have reported in detail on the problem. Further publications may be expected later from Germany, where an exhaustive investigation is being made, and from several institutions in America. While laboratory tests are essential before a metal is tried out in a dairy factory, it is obvious that a final conclusion as to the suitability for dairy equipment can only be reached after an extended test under factory conditions. The fabrication of a large sheet of metal free from irregularities, and from inclusions of slag and other impurities, is a more difficult task than the preparation of a uniform laboratory test piece. The reheating of the metal along the edges of the sheets for the purpose of making a welded join may introduce changes and irregularities not encountered in a straight laboratory test. Furthermore, it is difficult to simulate in the laboratory the actual conditions which a metal has to withstand in dairy practice. An endeavour was therefore made to obtain information from factories where the various metals had been tried out on the commercial scale, and from the manufacturers of dairy equipment.

Copper.

From the point of view of ease of fabrication, smoothness of surface, mechanical strength, and even, in many cases, durability, copper is a very suitable metal for dairy equipment, and in former years it was quite widely used in the industry. Supplee and Bellis (Journ. Dairy Sci., 1922, 5, 455), and Rice and Miscall (*ibid.*, 1923) have shown, however, that copper is dissolved in appreciable quantities even by fresh milk. These and similar laboratory tests, and difficulties in practice have led largely to the elimination in dairies of bare copper surfaces in places where they can come in contact with milk. This elimination is, however, by no means complete. The copper pipe was still being used in many dairies, in every country visited, for transference of milk from one holder to another. The copper evaporating-pan for condensing milk has not been superseded in any country, although for this purpose, in the future, nickel may prove a suitable substitute. It is especially interesting to note that Emmenthaler cheese (described in America simply as " Swiss " cheese) is invariably made in a copper kettle. In Switzerland, France, Germany, Denmark, Sweden, and the United States of America such kettles were seen in use. Emmenthaler cheese is made night and morning from perfectly fresh milk; the cooking-temperature is about 130° F., and the milk or whey is in contact with copper for about two hours before draining. After removal of the whey the vessels are immediately cleaned, and well scoured with sand to a bright polish. The author was informed that only cheeses of the non-acid type, such as Emmenthaler and Gruyère, can be made in the copper kettles. Samples of cheese made in such kettles were collected in southern Germany and in Switzerland, and analysed for copper, with the following results :—

	Parts Copper per Million.
Emmenthaler from South Germany	6
Emmenthaler from Switzerland	18
Petit Gruyère from Switzerland	9

Dr. Koestler, of the Swiss Dairy Experiment Station, supplied the following analyses of three cheeses made in Switzerland :—

	Parts Copper per Million.
1. Cheese from a Swiss farm dairy	40·0
2. Emmenthaler cheese	2·4
3. Cheese from Experimental Dairy, Liebefeld	4·0

Cheese No. 1 had been turned green by the excessive amount of copper which it contained, while cheeses Nos. 2 and 3 were of first-class quality, as were also those analysed by the author, one of which was twelve months old. When these figures are compared with the results of Davies, which show that butter can be rendered inedible in six weeks by the presence of one to five parts of copper per million, it becomes obvious that the catalytic action of copper in causing deterioration of dairy-products is governed, in some way not yet accurately defined, by the chemical and physical conditions existing in the product. The tentative conclusion may be drawn that copper is more active in an acid than in an alkaline medium.

In New Zealand dairy practice there is no opportunity for cheese-milk to take up appreciable amounts of copper ; but in many butter-factories there are in use coolers and holding-tanks for cream from which the tinned coating has been worn. Such equipment is a source of great danger. A sample of whey butter made in a Southland factory from cream which had been run over a cooler with much bare copper showing had a copper content of four parts per million. In England a sample of bleached New Zealand whey butter with a strong tallowy odour, submitted to the author by the Inspector of Dairy-produce, was shown to contain six parts per million of copper, which in the course of transhipment to England had rendered the butter quite unfit for human consumption.

It seems, therefore, that, except for Emmenthaler-cheese kettles, sheet copper will be gradually eliminated and replaced by other more suitable materials for use in dairy equipment.

Tinned Copper, Brass, Iron, and Steel.

Despite their disadvantages, which are no doubt sufficiently familiar to dairymen in New Zealand, these materials have not been superseded in any country for general dairy-work. The tinned-copper cooler, pasteurizer, and holding-vat, and the tinned-steel cheese-vat are still accepted equipment in dairy factories alike in Holland, Denmark, Sweden, and the United States of America. Copper is a good conductor of heat, and is easily worked into the shapes required, and steel and iron are relatively inexpensive. Moreover, fairly satisfactory results have been obtained from such equipment, and the dairy-owner or dairy company is reluctant to risk the uncertainty of a new material.

The fact remains, however, that the tin coating on copper or steel is not entirely satisfactory. When the sheet of iron and copper is smooth, and the tin coating has been well applied, it acts as a good protective agent, preventing copper from going into solution. Tin is, however, quite appreciably soluble in fresh milk and in lactic acid (Hunziker, World's Dairy Congress, 1928 ; Martell and Lincoln, Chem. & Met. Eng., 1926, 33, 622). It is not immune from the action of strongly alkaline solutions used for cleansing purposes, and, as it is very soft, it is easily removed by mechanical wear.

It is true that preparations such as " Soldo "* and " Bestin "* are now available for retinning corroded and worn surfaces *in situ ;* but it is also true that in factories in all the countries visited, as also in New Zealand, one could observe worn surfaces where the base metal was open to contact with the dairy-product. Recent tests in some butter-factories near

* The value of these preparations is now being tested out at the Institute here.

Palmerston North have shown that there is a distinct rise in the copper content of cream held overnight in vats showing only a small surface of bare copper. There is always a lag period between the time when a recoating is necessary and the time when the company agrees to submit to the necessary expenditure. During this period the dairy-product may suffer in quality. For these reasons, and because of the actual expenses of repair, the feeling is abroad among those interested that a material which gives a certain measure of satisfaction is not good enough, and much attention is being devoted to the problem of finding a substitute.

Aluminium.

From many points of view aluminium is a very suitable metal for dairy equipment. It is relatively not expensive, and it is not difficult to fabricate. It is quite distinctly soluble in milk; but aluminium salts are almost tasteless, and they have no effect on the flavour and keeping-quality of milk and other dairy-products, unless these have a very high acidity (*e.g.*, acidophilus milk, used in Europe and America as a beverage and for medicinal purposes).

For dairy-factory equipment aluminium has found its most extended use in Great Britain, largely owing to the activities of a London company, which has carried out a great deal of research on the methods of treatment and working of the metal. A city dairy recently constructed in Edinburgh has installed aluminium equipment wherever possible. A cheese-vat in aluminium at the Danish Dairy Experimental Station at Hillerod was giving satisfaction; but a member of the Swiss Dairy Experiment Station at Liebefeld, Bern, said that they had found aluminium an unsatisfactory substitute for copper in the Emmenthaler-cheese kettles. The curd had been found to adhere to the metal, and when separated by cutting it broke into small pieces unsuitable for the manufacture of Emmenthaler cheese. Apart from this effect, they found no noticeable difference in the cheeses from the two kettles.

The chief use of aluminium observed in dairies in other countries was for the construction of large holding vats and tanks for milk. A wagon used by a London city dairy for transporting milk in bulk from the collecting-station at Frome to London came under notice. The cylindrical tank is divided into three sections, each of which contains an aluminium holding-vessel. The wagon itself has a weight of 8 tons 4 cwt., and, when fully loaded, of 20 tons 4 cwt., representing a capacity of 2,620 gallons of milk. Aluminium is specially suitable for such a purpose on account of its lightness. The claim is made that the use of aluminium tanks in this wagon gave an extra capacity of 500 gallons of milk for the same total load.

Aluminium equipment for dealing with heated milk requires special care in manufacture, since the higher temperature enhances the effect of impurities in causing pitting of the surface. In a number of city dairies in England large aluminium vats are in use for pasteurization of milk by holding it at 145° F. for thirty minutes. After three years' service they showed no signs of deterioration.

Aluminium is not regarded as a suitable metal for whey-storage tanks.

A decided disadvantage of aluminium for use in dairy equipment is its softness and lack of strength. Its lightness would make it an ideal material for milk-cans, if this quality were not counterbalanced by the necessity of using thicker plate in order to obtain the requisite strength. Even under these conditions the bottom rim has to be made of steel, to give strength, and especially hardness, where it is most needed. The aluminium cheese-vat seen at the Danish Experiment Station had suffered considerable damage from mechanical abrasion. That a number of aluminium alloys of the requisite strength are available is obvious from their rapidly extending

use in automobile and aeroplane engine construction. The author has no information as to whether these are sufficiently inexpensive for use in dairy equipment, and whether they would withstand the action of milk and its products. Hunziker (*loc. cit.*, 1928) describes an alloy of manganese and aluminium which is resistant to the action of milk, but he gives no information as to its relative strength. Tests are now being made in the United States of America on milk-cans of an aluminium alloy which, it is claimed, has a strength comparable with that of steel. Seligman (*loc. cit.*) expresses the view "that none of the alloys of aluminium offer any hope of proving suitable for dairy purposes."

The purity of aluminium used in the manufacture of dairy machinery is a very important factor. The metal is especially susceptible to electrolytic action when in contact with another metal, and the presence of local impurities in an aluminium sheet causes serious pitting of the surface. It is well known also that cast aluminium is much less resistant to corroding agents than wrought aluminium, probably due to the entrance of impurities during the casting, as well as to the difference in physical condition. Impure aluminium has a marked tendency to stain at the surface of the liquid, where it comes in contact with air and liquid. Even the purest aluminium is not always free from this defect. It is especially advisable to wash aluminium equipment immediately after use, since the greatest damage occurs generally when the metal, contaminated with a film of milk solids, is left exposed to the atmosphere.

Probably the greatest disadvantage of aluminium for dairy equipment is its instability to the usual alkaline agents, caustic soda and alkaline carbonates, in which it rapidly dissolves. Addition to sodium carbonate of sodium silicate (ordinary water-glass) in the proportion of 1 part silicate to 2,000 parts of carbonate has the effect of completely retarding its corrosive action; and preparations, such as "Carbosil," are now available which contain the necessary protective agent. (It should be noted that sodium silicate does not exert its protective action with caustic alkali washing-powders.) It would appear, therefore, to the ordinary observer, as it appears also to the chemist, that the difficulty had been overcome; but whereas the scientist deals only with facts, the factory-manager must reckon with the human element. The author was repeatedly informed by technical chemists and factory-managers that they had found it impossible to induce the workmen to treat aluminium equipment with respect, by using only the special detergent for cleansing purposes. The secretary of a large Dutch co-operative organization for designing of dairy factories and for erection of dairy equipment stressed the inadvisability of installing into a factory any equipment requiring care on the part of the workmen, particularly if this is different from the other equipment in the factory. Similar reports were heard in America; and quite recently, in South Auckland, the information was received from the manager of a large dairy factory using aluminium holding-vats that it had been found necessary to forbid the use of any detergents whatever on the vats, as it was their experience that the workmen could not be trusted to use only the special cleansing-powder. While admitting the difficulty, the author does not regard it as an insuperable one. It should not deter a dairy company from purchasing in aluminium the equipment for which the metal is especially suited—viz., large holding vats and tanks for sweet milk and cream at ordinary temperatures.

The complaint was frequently heard that aluminium equipment cannot be repaired once it has become defective. Later information, however, indicates that such is not the case, although the operation requires a certain amount of skill. It is somewhat difficult to work the repaired portion to a smooth finish, and the strength of the sheet around the heated portion may be lessened through annealing during the process.

Nickel.

Nickel is more readily soluble than tin in milk and milk-products, more especially in milk with a high acidity. Hunziker, Grindrod, and Quam have, however, severally shown that the metal has no appreciable effect on the flavour and quality of sweet milk. Hunziker (*loc. cit.*, 1928) found under experimental conditions with nickel in the laboratory that a "slightly metallic and bitter flavour" was produced with "highly acid acidophilus milk, with starter, and with sweet cream, hot and cold." These effects were not noticed in actual practice with an all-nickel horizontal-coil vat installed in one of the factories of the Blue Valley Creamery Co. of Chicago. The vat was used for pasteurization, steam being passed through a horizontal coil which revolved in the cream, stirring it at the same time. Brine was then passed through the coil till the cream had been cooled sufficiently, and ripening was allowed to take place during twenty-four hours. Hunziker reports, "The vat has been in daily use for a period of over two years, and at no time has there been any indication of metallic flavour in the milk-product, although the nickel has lost its original lustre, shows considerable tarnish, and analysis of the cream by Quam disclosed the presence of appreciable quantities of dissolved nickel." It is open to question whether such favourable results would be obtained under New Zealand conditions, where the long delay between manufacture and consumption allows a full opportunity for metallic contaminations to exert their effect, although the evidence available indicates that nickel is a much less active catalytic agent than copper. A nickel cooler is at present under trial at the Massey College dairy factory.

The use of nickel in dairy equipment has hitherto been limited by its expense and by difficulties of fabrication. Both these difficulties are being overcome, and the metal is at the present time being used quite extensively for dairy purposes, especially in America. A large city dairy in Chicago has recently been fitted out with all-nickel equipment, including coolers of nickel. The only difficulty so far encountered is the tendency of nickel to tarnish in contact with milk. (Compare the results of Hunziker quoted above.) The manager of the dairy has been unable to find a cleansing agent that will effectively remove the tarnish, and it has been found necessary to polish the metal by hand once every week, a task involving quite a considerable expense.

Nickel is often used in the United States for the manufacture of heating-coils in coil vats the container of which is made of stainless steel, nickel being much more easily worked into coil form than stainless steel.

Grindrod has found nickel the most suitable metal for the fabrication of his patent sterilizing equipment for milk and cream, in which the temperature rises to 230° F. His company is now able to supply in nickel both the sterilizing equipment and the vacuum-pans for condensing purposes.

Nickel as a coating on other metals is not a satisfactory protective agent. Nickelled copper, for example, rapidly stains in black spots in contact with milk. Actually, since nickel is more soluble in milk than tin, no advantage over tinned copper could be expected from equipment of nickelled copper.

In some places difficulties had been encountered in the soldering of nickel, owing to differences in the coefficients of expansion. The difficulties were especially marked on a twist join.

Copper-nickel Alloys.

Of late years some alloys of copper with other metals, chiefly nickel, have been widely advertised for use in dairy factories. The most important of these alloys are monel metal and silveroid, both of which have

a bright silvery lustre. Hunziker's experiments show that they are not attacked so easily as copper by milk and its products, and that their effect on the milk-product is not so noticeable, although often quite distinct. It is Hunziker's opinion that " neither of the alloys give dependable protection against metallic injury to the flavour of milk-products."

In the countries visited the alloys were being used chiefly for milk pipes and connections, on account of the relative ease of fabrication. They are more suitable for this purpose than for vats, where the milk or cream is in contact with the metal for some time. They were not seen very much in use in cheese and butter factories. Silveroid appears to be of no use as a material for starter cans.

Silicon Irons.

In recent years, a number of high-silicon irons have been used successfully for acid-resistant equipment in the chemical industries. Their use for dairy equipment is, however, greatly restricted, owing to the fact that they cannot be *worked* into shape. Like cast iron, they are very brittle, and cannot be forged or rolled.

Stainless Iron and Steels, and Chromium-nickel Steels.

The so-called stainless steels are a development of the last fifteen years, since Brearley, in 1913, working in the joint research laboratory of Messrs. John Brown and Sons and Messrs. Thomas Firth and Sons, Ltd., of Sheffield, noticed that steels containing much chromium were not etched by the usual reagents. In 1914 stainless steel first became available to the public in the form of table cutlery.

It is important to note that the chromium steels are a class, not an individual alloy, and that the properties of the alloy vary with the carbon content, the chromium content, and the heat treatment it has received. Just as all grades of material can be obtained, varying from soft iron to a hard tool steel, by varying the proportion of carbon from nil to about 1·5 per cent., so similar grades of stainless iron and steel can be obtained by varying the carbon content from less than 0·10 per cent. in stainless iron to 0·70 per cent. in a stainless steel. A further variable has, however, been introduced—viz., the chromium—the proportion of which has a marked effect on the properties of the resulting steel. When an ordinary steel of the correct composition has been chosen for a specific purpose, it must receive specific treatment in order to produce the correct physical condition in the steel. In the making of razor-blades, for example, steel requires a special treatment. These facts are known to the layman as well as to the metallurgist. It is not so fully realized, however, that the " stainless " steels are available in a similar variety of grades, and that they require equally careful treatment. These details are included in order to stress the fact that it is as necessary carefully to choose a suitable grade of stainless steel for any particular purpose as it is to choose a grade of ordinary steel for its particular purpose.

There is a very important difference in properties between ordinary steel and stainless steel, the difference becoming more distinct with increasing content of chromium in the stainless steel. When ordinary steel is heated to a temperature above the carbon-change point—750°–800° C.—and is allowed to cool in the air, it is softened. In order to obtain a hard steel the hot article must be quenched—*i.e.*, rapidly cooled in water or in oil—according to the grade of hardness required. Stainless steels, on the other hand, have the property of hardening to a greater or less degree according to the composition, when allowed to cool in the air. Apart from the mechanical and physical properties, with which this paper is not so much concerned, such hardening has an effect on the corrosion-resisting

properties of the steel. It will be realized that with a large sheet of steel it is scarcely possible to get a uniform rate of cooling, unless a special furnace is used in which the rate of cooling can be controlled. It is thus easily possible that a sheet of stainless steel, unless it is very carefully made, may have different properties at different points on the sheet. It will also be sufficiently clear that a successful laboratory trial with a small test piece of steel in a corrosive liquid is not sufficient to justify the expectation that equal success will immediately be achieved with a large sheet in the same liquid.

The replies received by the author to his inquiries from dairymen in other lands as to their experience of the suitability of stainless steels for dairy purposes were very much at variance. When due consideration is given to the nature of materials and to their novelty, this was perhaps to be expected. A successful trial on the large scale is of much more importance than a number of failures, since it indicates that a uniform measure of success will ultimately be obtained, when more experience is gained in the manufacture and fabrication of the alloys.

In England and on the Continent of Europe dairy-machinery manufacturers were only beginning to realize the possible advantages of stainless steel for dairy equipment. In America there has been a great deal of research on the question, both by individual workers and by the staffs of dairy-machinery manufacturers. The results obtained by the individual firms have not been made public, but they are embodied in Hunziker's last report to the World's Dairy Congress. The two grades of stainless steel therein considered—viz., "Enduro" and "Ascoloy"—were found to be stable, in the form of small test pieces, to milk and its products under most conditions, and to washing-powders, disinfectants, and brines. They were attacked to some extent by the highly acid acidophilus milk.

The author has seen a number of cheese-vats and milk- and cream-holding vats made of these materials in dairy factories in the United States of America. In most cases the junction was affected by means of solder (stainless-steel sheets can be readily joined in this way, although the low heat-conductivity renders the operation perhaps a little slower). In some cases the vats were giving satisfaction, while in other cases rusting was evident at the junction and on other portions of the surface. The experience of one large dairy-machinery manufacturing firm may be worthy of quotation: As a result of successful trials with small test pieces in the laboratory, a large contract was taken to install stainless-steel holding-vats into a city milk-station. Within a year they had rusted so extensively that the firm was compelled to replace them by similar vessels of tinned copper.

It is the author's opinion that the above grades of stainless steel cannot be regarded as suitable substitutes for tinned copper in ordinary dairy practice.

Chromium-nickel Steels.

While the anti-corrosive properties of chromium-nickel steels were known before the actual development of stainless steel, they have not been used to any considerable extent until within recent years. They are now manufactured in England under the names of "Staybrite" and "Anka," in Germany as Krupp's "V.2.A.," and in the United States of America as "Allegheny metal."

As a result of his laboratory tests, Hunziker regards Allegheny metal (formerly called "Superascoloy") as the most suitable material for dairy purposes, on account of its almost complete resistance to the corroding action of milk and its products. These conclusions have been borne out in practice, and they would no doubt hold for the other three brands of chromium steels named above.

A Staybrite starter-can in use in a large cheese-factory in England was giving satisfaction, and the metal had not lost its polish after six months' use. Staybrite is being widely used in England in the brewing and allied industries, and, if it can be produced sufficiently cheaply, will probably be used on a large scale by the dairying interests.

In the United States Allegheny metal has been found to give satisfaction in dairy factories, both on account of its resistance to corrosion, and the absence of any deleterious effect on the milk. One large firm of ice-cream manufacturers has used a 1,000-gallon vertical holding-vat of Allegheny metal for two years without experiencing any trouble. They have found glass-lined equipment to be unsuitable because of its liability to mechanical breakage, and are now replacing it by similar equipment in Allegheny metal.

Allegheny metal has also been used to a considerable extent for coil vats for holding cream. In this case the coils are made of nickel, since it is not yet possible to fabricate Allegheny metal in the coil form. Such vats are giving good service, and have the advantage over all-nickel equipment that they do not require polishing.

The chromium-nickel steels are not so sensitive to electrolytic effects as ordinary stainless steels, and they can be joined more easily without suffering such serious alterations in their powers of resistance to corrosion. The material can be soldered, or joined by pressing, solder being used as a filling agent; or the join can be made by welding, with subsequent grinding-off to a smooth surface. The last is undoubtedly the most satisfactory junction.

In the manufacture of dairy equipment from chromium-nickel steels some difficulty has been encountered, since the alloys become harder with cold working. In the making of a form requiring extensive cold working it is necessary to reheat several times in order to keep the material in a workable condition. Furthermore, this hardening is accompanied by a lowering of the resistance to corrosion. Hence it is essential that the worked product should be finally reheated to 1100°–1200° C., and allowed to cool either in air or water. Some forms of equipment required in dairy factories are not yet available in chromium-nickel steels. The makers of Allegheny metal, for example, cannot supply milk-tubing with a polished internal surface. One large continental dairy-machinery manufacturer is now supplying milk-cans, buckets, strainers, and coolers in Staybrite steel. The cost of dairy equipment in chromium-nickel steels is considerably greater than that of similar equipment in tinned copper, both on account of high original costs of material and of high working-costs. It is, however, not so expensive as nickel. Although the author has no quotations for dairy appliances as used in New Zealand dairy factories, the following scale of comparative costs would probably apply:—

(1) 300-gallon coil pasteurizer-vat: All tinned copper, cost £140; with pure-nickel lining, coil, and cover, £115 extra; with pure-nickel coil, Allegheny-metal cover and lining, £100 extra.

(2) 100-gallon starter-can: Tinned copper, cost £45; with Allegheny-metal lining, £6 extra.

A quotation was obtained in England for welded whey-tanks in Staybrite steel of capacities 1,500 and 3,000 gallons, the respective prices being £140 and £180 — *i.e.*, less than half the price of glass-lined equipment of the same size.

Glass-lined Equipment.

Attempts have been made within recent years to eliminate the difficulties due to the interaction of milk and metals by the use of a neutral glass-like coating on steel vessels. Such equipment has for the most part taken the form of large holding-tanks for milk or cream. They have been

made with a jacket for steam or brine, but these have proved unsatisfactory on account of the corrosive action of the brine on the steel. The unjacketed glass-lined tanks and vats have been found to give complete satisfaction so long as the enamel remains intact. With careful treatment they give good service; but they very easily suffer mechanical damage, especially through the accidental dropping of a spanner, or through the rubbing of milk-cans. The most important objection to the use of glass-lined equipment is that it cannot be repaired. When the enamel has broken from its steel foundation in one place, replacement becomes necessary.

Glass-lined vats are being used in England, on the Continent of Europe, and in America for large lorry and railway tank wagons for the transport of milk for city milk-supplies. They do not, however, appear to possess any advantages over the lighter and much cheaper aluminium tank wagons being employed by one large London dairy.

When great durability is required, it seems that chromium-nickel steels of the Staybrite type will eventually replace glass-lined equipment for most purposes.

Summary.

In all the countries visited tinned copper was the most widely used material for dairy equipment. It has, however, the well-known disadvantage that the tin coating becomes worn away, leaving a bare copper surface open to contact with the milk or cream, with resulting possible deterioration of the dairy-product.

Copper alloys, such as monel metal and silveroid, cannot be regarded as desirable substitutes for tinned copper, although they are often useful for traps and junctions.

Aluminium is especially suitable for large holding-vats for milk or cream, and for milk-tubing, but satisfactory results will only be obtained if the metal is free from impurities. It is more resistant to corrosion in the worked form than in castings. Its softness renders it unsuitable for cheese-vats or for milk-cans. Experiments are being carried out in the United States of America on an alloy of aluminium and manganese, which has the requisite strength for milk-cans. Aluminium equipment must not be cleaned with caustic soda or ordinary washing-soda, in both of which it dissolves freely. A safe cleansing agent can be made by the addition of ordinary water-glass to the washing-soda solution.

Nickel is proving a useful metal for dairy equipment. It is dissolved to some extent by milk, but it produces no serious effects on the flavours. It has the disadvantage that it loses its bright lustre after a time.

Ordinary stainless steels have in some cases given satisfaction, but experience has been so variable, owing to the effect of slight differences in the mode of fabrication, that they cannot be recommended as reliable materials for dairy equipment.

The chromium-nickel steels are almost completely resistant to the action of milk and its products, and have given satisfaction in a number of large dairies in America. It seems probable that these materials will ultimately replace tinned copper or enamelled steel for many types of dairy equipment.

Aphis on Pear-tree Roots.—The Orchard Instructor at Nelson reports: "An instance of the dying of pear-trees from an attack of aphis on the roots came under my notice during March last. The foliage turned a purply-brown colour and fell off, and an examination of the roots disclosed the presence of aphis on the roots. The case was brought under the notice of Dr. Miller, of the Cawthron Institute, and experiments are to be undertaken for combatting the trouble.

CLEARING GORSE WITH THE DRAINING-SPADE.

A METHOD of hand-clearing big gorse, recently brought to my notice at Ohaeawai, is worthy of mention as being a considerable improvement on the mattock. The gorse is taken out by means of an ordinary 18 in. draining-spade, and the men using the implement assert that big clumps which would take from fifteen to twenty minutes or longer to remove with the mattock can be dug out with the spade in from

OPERATING ON A GORSE BUSH WITH THE DRAINING SPADE.
[*Photo by E. B. Levy.*

three to four minutes. In the case of a big clump the spade is used first of all to clear round the base by cutting off the low branches; then the surface roots are cut by sharp downward blows around the base of the plant about 9 in. from the stem. The spade is next driven down under the crown to cut the tap-root, and the plant is levered out. This is the quickest and best hand implement I have yet seen for the purpose.

—*C. J. Hamblyn, B.Agric., Instructor in Agriculture, Whangarei.*

BOARD OF AGRICULTURE PERSONNEL.

THE following have been appointed members of the Board of Agriculture for the triennial period ending 30th April, 1932:—Hon. D. Buddo, Messrs. J. Begg, Q. Donald, W. B. Grant, D. Marshall, W. W. Massey, W. Morrison, W. Perry, W. D. Pike, F. S. Pope, H. B. Stuckey, and D. W. Westenra. Mr. Perry has been named as President of the Board.

SEASONAL NOTES.

THE FARM.

SPRING-SOWN CROPS.

THE continuous wet weather experienced during July and on into August has greatly delayed all farm operations, especially in connection with the sowing of cereal crops. However, as opportunity offers this work should be pushed along and the best made of a late season. If a farmer finds he is too late for wheat, then oats or barley may be sown.

It has previously been noted that the tendency is for farmers to rely more and more on grass, and to reduce the areas of roots sown. Simultaneously with this there has been the desire to produce the best crop the smaller area will grow. This is as it should be. Great care should be taken to select the best strains of the type of crop it is decided to grow, and sow it under the very best conditions. This necessitates the selection of suitable land, the preparation of a good seed-bed, the full supply of a suitable fertilizer, and careful sowing and after-cultivation.

The varieties and kinds and quantities of fertilizers should be those that have proved most efficient in the district, and if the farmer is at all doubtful he can always get reliable information from the Instructor in Agriculture for his district. This officer is in close touch with all experimental work carried out by the Department of Agriculture, and in addition to this he has the results of the various farmers' field competitions and the actual practice of a large number of the most successful farmers in the district to guide him.

Rape, mangel, and carrot crops will, after the cereal crop, be the next to require attention, and, as has been repeatedly pointed out in the past, ploughing for these should be done as early as possible, followed up by frequent workings so as to destroy weeds and give the land the assistance of the sun to sweeten it. The destruction of annual weeds before sowing is of the greatest importance, and where the land cannot be ploughed early enough to enable this to be done, many successful farmers prefer to plough and sow at once, with the hope that the crop will get established before the weeds get too strong a hold. This is not good farming, but is certainly better than a half-worked field full of weeds. In preparing a seed-bed for roots care should be taken that it is fine from the bottom upwards. The question of the condition of the actual top soil is open to considerable difference of opinion. In districts with a light rainfall it is all right to have it fairly fine; but where the rainfall is heavy there is danger of it running together after sowing and spoiling the germination. Frequently newly sown fields that have had a heavy rain on them are covered with a thin crust which it is difficult for the seed to break through.

The best general practice for spring sowing is to leave the surface just a little rough in order to prevent this running together. Seeding may be done as early as the weather will allow, but it is bad practice to sow before the land is sufficiently warm to bring about a rapid germination. Unless these conditions exist the seed is better in the bag. Quick germination to get ahead of weeds should always be aimed at.

AUTUMN- OR WINTER-SOWN CEREALS.

Autumn- or winter-sown cereal crops require attention at this period. Frequently the surface of the land has run together as a result of heavy rains and the crop is not making satisfactory growth. One or more strokes of the tine harrow where these conditions exist will often work wonders. Care must, of course, be taken to see that the land is sufficiently dry to allow the harrows to go into the ground. Remember that it is necessary to loosen the soil up, not just draw the harrows over the field. One is not likely to do any harm by overharrowing. If the crop is at all yellow at this period it will generally pay to top-dress with 1 cwt. per acre of a good nitrogenous fertilizer—sulphate of ammonia or some other giving about the same amount of nitrogen. For full particulars of the treatment of cereal crops with nitrogen see this *Journal* for April, 1929, page 221. Reprints of the article referred to are obtainable from all Instructors in Agriculture or Fields Instructors of the Department.

PASTURES.

Pastures will now be making fair growth, especially in the earlier districts, and it is important that they should receive the best of management to ensure full returns during the growing season. If for any reason top-dressing has not been done, and it is still desired that this work should be carried out, there is plenty of time, provided a quick-acting fertilizer such as super is used. Many very successful dairy-farmers now follow up the practice of top-dressing in the autumn, with another dressing in September, and this system has a great deal to commend it. A nitrogenous dressing may also in some cases help at this period.

FIELDS FOR ENSILAGE OR HAY.

Fields intended for ensilage should be thoroughly cleaned and shut up as early as they can be spared. A careful clearing-up at this time, particularly of any wire or other foreign material, will save a great deal of trouble at mowing-time. The early shutting-up is most important, as it allows the grass to get a sufficient growth to allow it to be cut during November or very early in December. If this is done the grass is saved at its best, and the pastures are enabled to recover and get a good growth of clover and fine grasses before the dry weather sets in. This means that the clovers and better grasses are preserved in the sward. Ensilage-making should become a standard practice on every dairy-farm and on a great many sheep-farms. In addition to the advantages just mentioned, ensilage-making means that one is independent of the

weather, as it can be saved during showery weather just as well as in dry. It is practically safe from fire, and will keep for years if not required in the meantime. It is proposed to deal with methods of ensilage-making in the September *Journal*.

Fields for hay should also be cleaned and shut up, so as to have them at their best when the local weather conditions are considered likely to be right for haymaking. All fields to be shut up for ensilage or hay should be given 2 cwt. per acre of super at time of closing. If very rich in clover, 1 cwt. of sulphate of ammonia could also be applied with advantage. If, however, the clover content is already light no nitrogenous fertilizer should be used.

LUCERNE.

The growth on lucerne-fields will now be coming away, and it is a good time to shut them up, so as to get the the first cut off as ensilage, and have a second cut ready about the New Year for hay or green feed. The question as to whether a farmer should cultivate his lucerne at this period of the year or not often causes considerable thought. In dry districts spring cultivation is all right; but where the spring is wet it generally does more harm than good. If the land is dry enough a stroke or two of the tine harrow just before shutting up will help, otherwise it is best left until the autumn, which is really the proper time to cultivate lucerne.

—*Fields Division.*

THE ORCHARD.

SPRING WORK.

SPRING may be regarded as the beginning of a new season's work in the orchard, and the main activities will be those of spraying, cultivation, manuring, and in some cases grafting. In successful orchard-management work must necessarily be planned ahead, so that each operation may be undertaken and completed in its proper season. Pruning, if not already completed, should be pushed forward with all possible speed, and the orchard cleaned up ready for spraying operations, which must not be hampered in any way. It may be assumed that the spray outfit received its annual overhaul during the winter and new hoses procured where necessary. Nothing must be left to chance in connection with spraying operations, as a hold-up at such a critical time might prove to be a real disaster.

Successful control of disease in the orchard depends mainly on three important considerations—the time of application of a specific, the strength and suitability of the material for the particular purpose, and the thoroughness with which it is applied. Having numerous diseases and insect pests to control, the liability of certain materials to damage foliage and fruit if applied wrongly, and the different behaviour of varieties, make control measures somewhat complex for a beginner. Further advice may be secured from the Orchard Instructor for the district, however. The general health of the tree should be considered in connection with disease-control.

A tree weakened through continuous heavy cropping and lack of general attention is more liable to suffer spray injury than a tree carrying healthy foliage, thus making disease-control difficult, owing to the fear to apply sprays at sufficient strength for the purpose. Mildew is often a result of this general debility, and nothing but a reinvigorating of the tree by very hard pruning, better cultivation, and manuring will restore health.

SPRAYING OPERATIONS.

Pip-fruits.—It is usual to begin the season by applying an insecticide spray at the late dormant stage—usually the beginning of September—or at the very beginning of bud-movement. Red oil is the popular insecticide for this period, and used at a strength of 1–15 will clean up scale insects, &c., on apples and pears.

It may not be necessary to use this expensive spray every year on all varieties, especially on varieties of apples which receive strong applications of lime-sulphur for foundation sprays in the programme for the control of fungus diseases, as lime-sulphur in itself is a good insecticide. However, periodical applications of oil are advisable and necessary for the welfare of the tree. Lime-sulphur, 1–15, at green-tip, followed by a second spraying, 1–35 to 1–50, when the flower-buds are well expanded or showing some colour, may be applied to varieties of apples less liable to black-spot attack and probably more susceptible to powdery mildew.

Varieties such as Delicious and Dougherty usually receive a bordeaux spray, strength 6–4–50, at the green-tip stage, followed by lime-sulphur, 1–35, at the open-cluster stage. Bordeaux used later than the green-tip may cause serious russetting. Varieties receiving this initial fungicidal spray of bordeaux would require a late dormant oil spray.

For the control of black-spot on pears bordeaux is recommended, the first application being made at green-tip, strength 6–4–50, followed by a 3–4–50 mixture at the pink stage. Lime-sulphur may be used in place of the second bordeaux on such varieties as P. Barry, Josephine, and Winter Cole, which are less liable to attacks of black-spot, and do better under lime-sulphur treatment.

Stone-fruit.—For the control of leaf-curl, shot-hole, &c., on stone-fruits bordeaux must be used, the first application at bud-movement, strength 8–6–40, probably having been already applied. On varieties particularly susceptible to leaf-curl, a second application should follow at the pink stage, at strength 3–4–40. Sometimes lime-sulphur, 1–50, is used at the pink stage, and is probably an important application for brown-rot control. The stone-fruit grower, however, should be prepared to fight brown-rot from the fruit-set period with sulphur in the precipitated form, 10 lb. to 100 gallons, or dry-mix sulphur (16 lb. sulphur, 5 lb. lime, 8 oz. casein, in 100 gallons). The times of application will depend on weather conditions. It may prove necessary at times to allow not more than a week between sprayings.

CULTIVATION.

The value of good tilth in the orchard during the summer is fully realized. However, to be certain of securing that good

tilth, early preparation is necessary. Cover-crops, if growing, should now be turned under and allowed to rot before dry weather sets in. If no autumn ploughing has been done, the land should be turned over as early as possible if conditions are suitable. Where the land has been autumn ploughed, further cultivation work may be deferred for a short time, but the land should be worked down before growth begins.

MANURING.

It is reasonable to assume that fruit-trees, particularly heavy-bearing ones, remove each year large amounts of available plant-food from the soil, and that unless a regular and adequate supply of such plant-food is made available trees must decline in growth and productiveness. By cultivation we help the changes constantly going on in the soil whereby plant-food becomes available. However, it is recognized nowadays that this supply of plant-food must be supplemented by the use of fertilizers, otherwise production will go down. On the other hand, by a studied application of fertilizers production may be increased sufficiently to give a good margin of profit over the cost of manuring. If quick-acting chemical fertilizers are being used, applications should be made just before bud-movement, giving a dressing of from 4 lb. to 8 lb. of a complete fertilizer per tree, in the proportion of 1 lb. sulphate of ammonia, 4 lb. superphosphate (44/46 per cent.), and 1 lb. sulphate of potash.

GRAFTING.

The reworking of trees by the grafting method may be undertaken as soon as growth begins. From the middle of September, trees are usually in a fit condition, but the work should not be carried on after the middle of October. Scions must be in good condition—that is, quite sappy, but not too forward. Clean cutting, good binding, and exclusion of air about the union are three important points to effect if this operation is to be successful. Carelessness in these details, and a resultant poor "take" of grafts, means a year lost and probably some detriment to the stock. Binding may be done with raffia or with strips of waxed cloth. In the former case grafting-wax is smeared round the union.

The popular method of reworking old stocks is by rind-grafting. The scion, consisting of a length of the preceding year's growth—preferably about the thickness of a lead-pencil and shortened to three buds—is cut to a wedge; a short cut is made vertically through the bark of the stock, and the bark on one side of the cut is lifted carefully to admit the scion; the wedge-shaped scion is pressed down beneath the bark of the stock; one edge of the wedge of the scion is pared off while being prepared, so that this edge will lie against the unlifted edge of bark on the stock when the scion is pushed home.

FRUIT IN COOL STORE.

Fruit in cool store should be examined frequently for condition. This applies particularly to pears and large-sized Sturmers, which should be marketed early if showing signs of maturity.

—N. J. Adamson, Orchard Instructor, Hastings.

Citrus-culture.

Planting.—This is the most desirable period of the year for planting out the various varieties of citrus-trees. Soil conditions are now becoming more congenial, and showers may be expected to assist the trees to establish.

The most important factor in planting is that the soil shall be in good condition, well worked, friable, and by no means sticky when the soil is filled in round the roots; if sticky, it is impossible to get the desired firmness of planting without unduly consolidating the soil. The subsoil immediately under the tree should not be disturbed to a greater depth than the surrounding subsoil has been worked. The hard ball of earth round the roots as received from the nursery should be broken up and the roots evenly spread, and the soil well firmed, except the top 2 in., which should be replaced quite loosely. Fertilizers—say, 1 lb. of blood-and-bone—may be worked in round the tree after planting, or mixed with the soil used to refill the hole, but never dusted into the hole in such a way as to allow the roots to come in direct contact with the fertilizers.

If the situation is in any way exposed to wind, young trees should be supported with a strong stake inclined towards the prevailing wind, and securely tied, but in such a way as not to injure the tree.

Established citrus-trees will greatly benefit by an application of artificial fertilizers, or farmyard manure if such is available. An amount of 4 lb. blood-and-bone, 4 lb. super, and 2 lb. sulphate of potash should be applied to each tree which is in bearing, and a lesser quantity in the same proportions for smaller trees.

Cultivation.—All citrus-groves should be worked, so as to turn under any green crops or weeds and permit decay before the dry weather sets in.

—*W. H. Rice, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

FINAL HATCHING.

It may be well to again stress the great importance of placing the last of the eggs for the season in the incubators or under the natural mother before the end of September, or early in October at the latest. There are many factors to be considered in successful poultry-keeping, but none of greater importance than the avoidance of late-hatched stock on the plant. It is a weak policy, even in normal times, to delay hatching operations beyond the right season, but in these days of high-cost foodstuffs and low-priced eggs it is particularly important that the young birds be hatched out during the early season.

There is yet ample time to hatch out ducklings for the renewal of the laying flock, but September should see all eggs undergoing the process of incubation for the production of ducklings for the Christmas market. To cater for this trade the eggs should be put

down about fifteen weeks before the young birds are to be marketed. This will allow twenty-eight days for hatching (the natural time), and the remainder for rearing the birds to prime condition. One little point may be mentioned here in regard to mating ducks. They should be mated well in advance before the eggs are required for hatching purposes, otherwise a high proportion of infertile eggs may be expected. Usually ducks, especially the heavy breeds, have to be mated much longer than fowls in order to ensure a maximum number of fertile eggs.

CHICKS DEAD IN SHELL.

Quite a number of poultry-keepers have sought my advice regarding troubles met with in their work of incubation, the chief trouble being the finding of fully developed chicks dead in the shell at hatching-time. How to advise is a problem, as no definite cause can be attributed to this condition. It may be due to one or a combination of causes. The breeding-stock may be responsible—breeding from overfat hens that have insufficient exercise, or birds that have been overforced for egg-production, may easily account for the chicks failing to hatch.

Like many other troubles met with in producing chicks by artificial means, the one in question can only be satisfactorily dealt with by taking into account all the local conditions surrounding the parent stock and the development of the chicks during all stages of the incubation process. Very often in a close examination of the eggs which do not hatch many things may be observed indicating a probable reason for the failure. Sometimes it will be found that the chick is so large that it would be impossible for it to make the natural movements to cut its way out of the shell. In other cases the air-cell is dried down too far, and the membrane under the shell is so tough that the chick cannot pierce it, and consequently dies in the shell. In the work of incubation the aim should be to have the air-cell almost one-fourth the size of the egg at pipping-time—in other words, dried down to where a chick would be expected to pip when under the natural mother. The size of the air-cell can be controlled to a great extent by the amount of cooling, ventilation, and moisture applied during the various stages of the incubation process.

Where it is found that the air-cell is drying down too fast moisture should be applied to check this, either by putting water in the trays provided or by keeping the floor of the incubator-room in a moist or more or less wet condition. Besides this the ventilation space should be reduced. On the other hand, where the air-cell is not coming down to a desired line at, say, about the fourteenth day, and the eggs appear when testing to be more or less clear just under the line of the air-cell, the presence of excessive moisture is usually indicated. In this case the ventilators should be opened wide to allow the moisture to escape. If the cell is considered to be too small, and the egg appears to be dark right up to the membrane enclosing the air-cell, this indicates that the chick is growing too fast, and if not checked will be too large at the pipping stage to turn in the shell, thus failing in its effort

to hatch out. This no doubt accounts for the remarks so often heard that the chicks found dead in the shell are usually of exceptional size.

Where it is found that the chick is making too rapid growth the only safe course is to reduce the amount of ventilation and cooling, in order to prevent the developing chick from obtaining too much oxygen and thereby growing to an unnatural size.

Study of the air-cell is thus a matter of vital importance, for upon the operator's knowledge of how and when to apply moisture, cooling, and ventilations, depends largely the success or otherwise of the incubator work. The importance will thus be seen of carefully studying the diagrams shown in the usual book of instructions supplied by the makers of incubators, indicating what the conditions of the air-cell should be at the various stages of the incubation period. As to the air-cell theory, it may be said, and rightly so, that eggs may be found with greatly varied sizes of air-cell at practically all stages of incubation. There is usually, however, a cause for this which does not prove the air-cell theory to be wrong. For example, where washed and unwashed eggs are placed in the same incubator the unwashed will dry down much more rapidly than the washed, resulting in ununiform air-cells. The same applies where stale and fresh eggs are set together, as, obviously, the more stale an egg is the larger will the air-cell be at the outset. For this reason eggs intended for incubation should be as near the same age as possible. Where eggs of different ages are used a more uniform air-cell can be struck by placing moisture in the machine for the first three or four days. In this way the stale eggs with more dried-down air-cells (as compared with those that are fresh), owing to the evaporation of moisture that has taken place, will take up to some extent the added moisture, and consequently more even air-cells will result.

While the studying of the air-cell is of importance in the management of an incubator, the fact cannot be emphasized too strongly that this and the carrying-out of other necessary details will count for little if extreme variations of temperature are allowed to take place. Especially should a fluctuation of temperature be guarded against during the first few days, or trouble is almost sure to be experienced at hatching-time. In speaking of the importance of a uniform temperature, it may be well to point out that thermometers do not always register the correct degree of heat that is being maintained in a machine. A case in point recently came under my notice. Three new thermometers were purchased; these had stamped upon them "guaranteed," but on being tested showed different readings of temperature up to 5 degrees. It is always a wise course to test a thermometer before use in connection with incubator work.

How to test a thermometer: Place a clinical thermometer and the one to be tested in water at 100° F., stir gently, add slowly at the same time hot water, and observe the different readings. If the incubator thermometer reads, say, a degree lower or higher than that of the clinical one it must be worked a degree higher or lower accordingly.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

SPRING WORK.

By the time these notes appear the first examination of the hives should have taken place. As stated last month, the question of stores is of first importance, and every effort should be made to provide the bees with ample food to carry them on until nectar is available. Owing to the comparative severity of the winter this year, particularly in the South Island, it may be found in many cases that the bees have not consumed as much honey as usual. The weather conditions will probably also have influenced brood-rearing to a large extent, and, although brood may normally be found in the hives by the end of July, this year abnormal conditions have prevailed, and it will be unwise to judge a colony queenless because there is no brood showing at a first examination. With the advent of warmer weather the colonies will soon build up to their usual strength.

When colonies are weak, or show other signs of a poor queen, it is best to kill the queen and unite the colony with a stronger one. It is useless to try and carry a poor colony on to the summer. By the time new queens are available it will have nearly dwindled out of existence—if it has not been robbed out: and even if it lives until it can be requeened it will hardly build up sufficiently to give a surplus in the coming season. Only strong colonies should be tolerated in an apiary, and it is much the better plan to dispose of all the weak stocks and prepare the hives thus vacated for increase later on. A simple method of uniting is to place the weak colony over the strong one with a single sheet of newspaper between the two hive-bodies. The bees will gnaw the paper through and unite quite peacefully in a day or two.

PRECAUTIONS AGAINST ROBBING.

All work which necessitates opening the hives should be carried out as expeditiously as possible, and no hives left open longer than can be helped. No combs should be exposed to the bees at this time of the year. It is a good plan to carry round on a barrow an empty super, in which the end combs can be placed and covered while the work of examining the colony is going on. It is necessary to remove one comb at least, so that the rest may be easily handled, but this comb, however dry, is as well kept out of the way of would-be robbers. Spring robbing, once started, may become as disastrous as autumn robbing, and must on no account be encouraged. All feeding should be carried out just before dusk, and if any syrup is spilled it should be at once covered up or removed out of harm's way.

STARTING AN APIARY.

The beginner who is desirous of starting an apiary may commence at any time now. For the next month or two he will only be able to obtain established colonies, as swarming is still some time ahead. If he decides to commence at once, and thus obtain

the full benefit of the season's experience, he should get into communication with a reliable breeder and obtain nothing but absolutely guaranteed stock. On no account must the tyro be led away by the apparent cheapness of bees offered for sale. If he contemplates purchasing any other than those of any apiarist who makes the sale of bees his business he should have his prospective purchase examined by some person of experience, and be quite certain of the cleanliness of the colonies before taking possession. The sale of diseased bees is forbidden by law; but, apart from that, they are a dear bargain, as they will cost much in money and time to bring them to a healthy condition, and, moreover, will yield nothing during the first season. A good hive purchased now, placed in a sheltered position, and carefully watched to see that its stores are sufficient to last it till nectar is abundant, will probably (if the apiarist desires it) yield a good swarm, and both parent hive and swarm should give a surplus when the main honey-flow arrives.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

THE TOBACCO CROP.

Boxes of seedling plants will now be to hand from the nurseries ready for pricking out into the plant-beds. For this purpose the plants should be well hardened off, and to make sure of this they should be placed on the beds for a few days at least to prove their condition. Place the hessian cover in position over them, and keep them slightly on the dry side. If they prove satisfactory, water them well the day before they are to be planted out. Then with the planting-board open a small trench across the bed and place the seedlings 1½ in. apart, carefully covering the roots. The opening of the next trench, 1½ in. distant, completes the closing of the trench already planted. In about five days the plants should have begun to establish themselves in the soil, and should be showing indications of further growth. From eight to ten days after planting, when the young plants are well established, water the plants with a solution of one eggcupful of nitrate of soda in a kerosene-tin of warm water. The plants usually grow quickly and will smother any weeds. The plants should be ready for planting out in the field by the beginning of November.

If seeds have been sown in the plant-beds and germination is uneven, thin the crowded plants to prevent them becoming drawn and weak. These thinnings may be used for pricking out on bare patches on the beds. In either case cover the beds securely with cheesecloth or hessian to shade the plants and protect them from cold temperatures.

The preparation of the land in which the crop is to be grown will now consist of occasional light cultivation in fine weather to destroy weeds and aerate the soil. If lime has not been applied during the winter the dressing should be given now; from ½ ton to 1 ton per acre is usually sufficient. This should be drilled or

broadcast and worked in with the cultivator. For land known to be poor in plant-foods make up a mixture of 5 cwt. superphosphate and 1 cwt. sulphate of potash; broadcast 2 cwt. of this one month after liming, and work it in; the remainder can be used as required after the plants are set out. The rates given are per acre.

TOMATOES.

The watering and ventilation of tomato crops under glass will require the closest attention if heavy and early crops are to be obtained. Drawing the plants up through keeping the house too close in warm weather, or chilling them by too much ventilation when a cold wind is blowing, are the commonest mistakes made with the crop at this season. Such treatment delays and diminishes the time and size of the first and more valuable bunches of fruit. The neglect is less likely to take place if this responsibility of attention to the houses is expressly assigned to one person.

The outside tomato crop often follows a winter crop such as celery or spring cabbage or cauliflower. This land is usually very rich, and when given a further heavy dressing of chemical fertilizers it is not surprising that the vigorous growth obtained is accompanied by black-stripe disease or late-blight. A better result in such cases will often be obtained by a dressing of lime harrowed in after the first ploughing, and a moderate application of superphosphate and sulphate of potash with the last cultivation before planting. The ensuing crop will be more healthy and thrifty, and can be easily "pushed" along, if considered advisable, by further applications of manures after it is established.

STRAWBERRY-BEDS.

Strawberry-beds that are not in vigorous condition will be much benefited now by a dressing of superphosphate and potash, 2 oz. of the former and 1 oz. of the latter per square yard is a moderate dressing. Much heavier dressings are given to plants on poor lands. Work the manures in with a light cultivation. Material for mulching the beds should now be obtained. Rushes and pine-needles are sometimes used for the purpose, and are quite satisfactory. Baled straw is also popular; if it is placed on the headlands to weather some time before use it is all the better.

THE MARKET-GARDEN.

Light hoeing in fine weather to destroy seedling weeds among sown and planted crops is most important at this season, as it encourages crop-growth and makes light work of weeding.

Sow radishes, lettuce, spinach, main-crop carrots, beet, and peas. Plant main-crop potatoes and asparagus. The latter crop (asparagus) is becoming more popular, and is profitable on good moist sandy loams. It should be planted only after thorough preparation, as the beds remain down for many years. Where this preparation has been given open trenches 3 ft. to 4 ft. apart and 10 in. deep, plant good selected well-graded seedling roots 18 in. apart, and cover firmly with 2 in. of soil. Allow the trenches to fill gradually as cultivation proceeds during the summer. Intercropping may be

done during the first season, as long as the asparagus crop is not interfered with. Established beds should now receive a further dressing of fertilizer; 2 oz. each of superphosphate and nitrate of soda and 1 oz. sulphate of potash per square yard will generally be found suitable.

In the warmer parts of the North Island dwarf beans and vegetable marrows are sown towards the end of September. The practice of some growers to raise ridge cucumber plants now under glass for planting out later in the field for early cropping is profitable where a warm moist friable soil is available for the purpose.

For many years slugs have taken a heavy toll in the garden at this season among seedlings and salads, and an indignant host of angry growers has formulated many recipes for defeating the attack of this persistent insatiable pest. Dusting a crop with lime just before retiring to rest is an irksome and unpleasant task. Of the many experiments with White Island Product, one of the most interesting and successful was a dressing applied to the land a week or two before planting-out lettuce seedlings, with the pleasing result of their being comparatively free from this invasion. Finely powdered alum mixed with twice its weight of lime is a good repellant dust for this purpose, or two tablespoonfuls of strong liquid ammonia to 3 gallons of water sprayed with a fine nozzle. Kainit or nitrate of soda are good slug-killers, as also is sulphate of copper. An amount of 1 lb. of powdered sulphate of copper and 20 lb. kainit, mixed and broadcast evenly on a suitable evening at the rate of 1 oz. per square yard, is given as a perfectly reliable remedy. Another is ½ lb. quicklime dissolved in 4 gallons water, the clear liquid strained off when cold, and added to 1 lb. of alum dissolved in 1 gallon of water. The effect of any of these methods is best when they are applied after the slugs have come out to feed—that is, in moist weather for preference and after sunset.

Of the many recipes for defeating the woodlice pest in cold frames and glasshouses for seedlings, &c., the best has been demonstrated by Professor Theobald to be 1 lb. of fine powdered Paris green and 28 lb. bran. Mix them well together, and broadcast the material in a dry state at the rate of 1 oz. to the square yard. The soil should not be watered for some days after treatment.

WEED-KILLING IN THE HOME GARDEN.

The usual annual crop of weeds will now appear in the water-tables and at the sides of walks and drives. One or two applications of good weed-killer is the best method of dealing with this problem where the area is considerable. For this purpose sodium chlorate has been used in France and America with great success; it is even effective in destroying satisfactorily the troublesome convolvulus. It is not poisonous, but is inflammable, and directions given with it should be strictly adhered to. An amount of 100 lb. sodium chlorate dissolved in 100 gallons of water is sufficient for 1 acre of land—that is, 1 gallon for about 48 square yards.

—W. C. Hyde, Horticulturist, Wellington.

BREAKING DOWN AND TEARING OUT GORSE BY TRACTOR AND SWAMP-HARROW ON THE FLOCK HOUSE TRAINING FARM ESTATE.

PLOUGHING GORSE-CLEARED LAND AT FLOCK HOUSE WITH TRACTOR-HAULED SWAMP-PLOUGH.

This operation followed the breaking-down work shown in top photo and subsequent burning. The plough is claimed to be the biggest one of its kind built in New Zealand, turning a furrow 26 in. by 11 in.

WEATHER RECORDS: JULY, 1929.

Dominion Meteorological Office.

GENERAL NOTES.

THE month of July was on the whole a cold, wet, and unsettled one, but except for a few occasions there was an absence of strong winds. Rainfall was again considerably above the average over most of the Dominion, though deficiencies were recorded in some districts. In the South Island these were experienced south of Westport, in Southland, parts of the interior of Otago, and at a few places in North Canterbury. In the North Island, places on the east coast and about Wanganui and Taihape received less than the normal. The greatest differences from the average occurred at Lambrook Station, Fairlie, with 263 per cent., and Timaru, with 169 per cent. above, and at Okuru, South Westland, with 60 per cent. below.

Temperatures were everywhere lower than the average for July. Frosts were fairly numerous and in some cases severe. There was in consequence little growth of pasture, but owing to the absence of high winds the actual damage to vegetation was very slight. Snowfalls were frequent and copious in the high country of both Islands, though none lay for any time on the low levels.

The most notable meteorological feature was the tendency for anticyclones to pass north of New Zealand. There was only one which proved an exception in this respect—namely, that which moved across the Dominion between the 3rd and 5th. Fine weather prevailed generally on these three days.

Cyclones were again very prevalent, and even when depressions were of the westerly type originally they had generally developed cyclonic form by the time they reached the Dominion. The first of the more severe cyclones experienced moved on to New Zealand on the 7th, and at 9 a.m. was centred off the west coast of the South Island. During the night of the 6th, north-easterly winds increased to gale force in many parts, and at Christchurch the wind was exceptionally violent. Rain set in and became general on the 7th. The Nelson and Marlborough Districts experienced particularly heavy falls at this time, and the resulting floods caused considerable damage through low-lying ground becoming inundated and through numerous landslips.

A week later, on the 13th, another cyclone advanced on to New Zealand, its centre being located off Puysegur Point on that date. This disturbance proved to be a slow-moving one, and a controlling influence over our weather was exercised by it until the 19th. This period was the wettest portion of the month. Heavy rains were recorded every day over large areas of the Dominion, and the total amount of precipitation produced by the storm was very great. On the 14th the Nelson District again suffered from floods, and serious damage was done. In Canterbury and Otago also floods resulted from the prolonged heavy rains. Main-road communication was interrupted both north and south of Timaru and on the Mount Cook route. The Taieri Plain was covered with water. Fortunately, ample warning was provided, and stock were removed to high land in time to prevent serious loss.

By the 20th the cyclone centre had passed eastwards, and a brief respite of almost spring-like weather was experienced on this day. During the night, however, rain again set in with cold southerly winds. On the 22nd and 23rd, while an anticyclone was passing north of New Zealand, fair weather prevailed. From this date onwards, however, cold, changeable, and showery conditions were the rule, though mainly fair weather was experienced on the 27th and 28th.

RAINFALL FOR JULY, 1929, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	9·39	23	2·00	5·96
2	Russell	4·21	16	1·09	4·97
3	Whangarei	5·98	23	0·95	7·26
4	Auckland	6·22	25	1·06	4·98
5	Hamilton	6·44	20	1·50	5·02
5A	Rotorua	6·90	11	2·00	4·89
6	Kawhia	6·70	20	1·50	6·16
7	New Plymouth	9·17	24	2·23	6·29
8	Riversdale, Inglewood ..	11·60	24	1·93	9·93
9	Whangamomona	7·02	13	2·05	7·35
10	Eltham	9·41	25	1·26	5·55
11	Tairua	5·90	15	1·78	5·25
12	Tauranga	4·72	16	1·26	4·86
13	Maraehako Station, Opotiki	5·04	12	2·02	4·09
14	Gisborne	4·79	17	1·86	5·14
15	Taupo	5·37	12	1·05	3·83
16	Napier	2·00	15	0·67	3·90
17	Maraekakaho Station, Hastings	1·71	14	0·65	3·65
18	Taihape	3·34	21	0·92	3·15
19	Masterton	2·42	19	0·49	4·31
20	Patea	5·13	20	0·55	4·20
21	Wanganui	2·73	16	0·55	3·52
22	Foxton	3·71	13	1·01	3·09
23	Wellington (Karori Reservoir)	8·20	24	1·14	5·22
	South Island.				
24	Westport	9·13	19	1·92	6·99
25	Greymouth	7·18	13	1·50	7·84
26	Hokitika	7·81	13	2·36	9·08
27	Ross	8·31	12	2·70	9·94
28	Arthur's Pass	8·69	13	2·70	11·55
29	Okuru, Westland	4·80	6	2·00	12·03
30	Collingwood	14·24	24	2·96	9·65
31	Nelson	9·21	13	1·64	3·49
32	Spring Creek, Blenheim ..	7·50	12	2·25	3·40
33	Tophouse	7·67	15	1·45	4·79
34	Hanmer Springs	3·71	14	0·66	4·59
35	Highfield, Waiau	3·16	10	0·84	3·44
36	Gore Bay	3·74	11	0·56	2·84
37	Christchurch	3·70	16	0·64	2·76
38	Timaru	5·20	10	1·58	1·93
39	Lambrook Station, Fairlie ..	9·47	10	3·68	2·61
40	Benmore Station, Clearburn	1·82	15	0·42	1·73
41	Oamaru	4·24	9	1·32	1·74
42	Queenstown	2·02	11	0·45	2·04
43	Clyde	1·27	11	0·26	0·94
44	Dunedin	6·24	17	1·74	3·01
45	Wendon	1·56	12	0·28	1·79
46	Gore	2·00	19	0·29	1·94
47	Invercargill	2·10	19	0·40	3·28
48	Puysegur Point	4·56	19	0·50	6·18
49	Half-moon Bay	2·20	16	0·69	4·13

—*Edward Kidson, Director of Meteorological Services, Wellington, 6/8/29.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

ENSILAGE FOR SHEEP.

F. J. ELLIS, Bulls :—

I should be glad of any information you can give me in regard to feeding ensilage to sheep, more particularly to ewes in lamb and with lambs; whether it is desirable to feed alone or in conjunction with hay, and any other useful information connected with the matter.

The Live-stock Division :—

As a foodstuff for ewes in lamb ensilage is not considered satisfactory. There is a danger of severe digestive disturbances being set up, the main issue being the harmful acids and moulds which result from improper fermentation of the ensilage. There is also the danger of in-lamb ewes not taking sufficient exercise, predisposing them to "bearing-trouble" and ante-partum paralysis. Ensilage is a foodstuff which must be fed with great care in the case of ewes. Only very small amounts daily should be allowed at the commencement, and as this is a succulent feed, hay should be given in addition. Under such circumstances the necessity of forced exercise in pregnant ewes cannot be overlooked. The feeding-value of well-prepared ensilage is superior to that of roots, but mouldy or sour ensilage should not be used under any circumstances for pregnant ewes.

TREATMENT FOR SOD-BOUND PASPALUM PASTURE.

L.A., Titirangi :—

Can you give any information as to how to deal with sod-bound paspalum pasture? We have a paddock which has been down for over fifteen years, and is in such a bad state that it throws little feed, and very poor quality at that. The roots form such a dense mass as even to exclude water from the soil, the rain-water being held as in a sponge by the root-system. I notice also that moss is bad in this paddock. The land has a clay subsoil, is hilly in contour, and is easily ploughable.

The Fields Division :—

Neglect of top-dressing and thorough harrowing is a contributing cause of the sod-bound condition of paspalum, and many sod-bound pastures can be brought back by systematic harrowing and regular top-dressing with phosphates. Given the conditions mentioned in your letter, the best plan for rejuvenating your pasture would be to plough and resow in rye-grass and clovers. Plough the land in the late winter, with the furrow-slices lying on their edge; avoid turning the paspalum turf right under. Roll on the furrow, and disk and sow in September about 15 lb. of perennial rye-grass, 2 lb. crested dogstail, 2 lb. red clover, and 1 lb. white clover. Fertilize with 3 cwt. of basic slag. The paspalum will root again in the fresh soil which has been turned up, and will come up in a rejuvenated condition along the edges of the furrow-slices. Given good management and top-dressing you should be able to maintain a rye-grass-paspalum pasture, following the establishment of the rye-grass and clovers after ploughing.

CANKER IN DOG'S EAR.

F. H. WALLIS, Whakapirau :—

I have a valuable young sheep-dog about eighteen months old, which for the last six months has been badly troubled with his ears. I am told it is "canker." The inner portions of both ears swell until there is a complete blockage. This causes him to scratch his head a great deal and whine as though

in pain. I have tried washing with disinfectants and applying lard and sulphur, also olive-oil. At first this treatment seemed to do good but is now of little use. I would like your advice as to treatment, &c.

The Live-stock Division :—

Canker in the ear of a dog is usually caused by a small mange-mite, and therefore may spread to other dogs which come into close contact with one affected. The local treatment advised is to clean the affected part very gently with a wad of cotton-wool soaked in a mixture of one part methylated spirit and five parts water. This should be done weekly throughout the treatment. Every second day a few drops of citrine ointment (one part) and olive-oil (eight parts) should be dropped into the ear. It would be advisable to obtain, say, 4 oz. of this mixture from a chemist. The cheeks and the outer side of the ears should be washed with some disinfectant occasionally. The general treatment is to provide the dog with warm dry quarters and to give him daily exercise.

STORING SWEDES FOR SHEEP.

"SUBSCRIBER," Waihao Forks :—

In carting out swedes from the paddock to sheep in June, July, and August we often experience difficulty because of the boggy state of the ground owing to winter rains. If the swedes were carted off early in May and heaped, would they be as palatable and nutritious as if carted fresh from the ground? How long would they keep pitted?

The Fields Division :—

It is not likely that your swedes would have finished growing until the end of May. They could then be carted off the field and placed under the shelter of a plantation or hedge and covered with straw. If the tops were removed the roots would keep until the end of August. Stock generally show a preference for roots that have been stored, as long as they have been kept in sound condition, and the amount consumed is apparently less than when eaten off in the paddock.

SUSPECTED COW-POX.

W.H.A., Glenavy :—

Some of my cows have lumps forming in the udder. They come to a head like a boil, and discharge. Could you tell me what the trouble is and a cure for it?

The Live-stock Division :—

The lumps referred to may be small abscesses which sometimes occur in the udder, or more probably they are cow-pox postules, which are infective and are often spread from cow to cow by the milker's hands or cloths used in washing the udder. If the former, keep the parts clean by using a weak solution of permanganate of potash (Condy's crystals); but if the latter (which we suspect), besides keeping the affected udder clean and dry it is advisable to milk the animals with care, the affected cows being milked last and the hands well washed after milking. A little zinc ointment should be applied to the ulcers.

Condition of Dairy-farm Milking Sheds.—During the year ended March, 1929, the Farm Dairy Instructors of the Agriculture Department visited 45,683 sheds. Of this total, 22,222 sheds were classed as good, 21,387 as fair, and 2,074 as bad.

The plant Tourretia volubilis has been declared to be a prohibited plant within the meaning of the Prohibited Plants Act, 1927. *Tourretia volubilis* is a half-hardy twining plant, native of Peru, with tetragonal branchlets, opposite compound leaves, furnished with branched tendrils. Flowers in terminal racemes, corolla of a dusky violet colour, fruit an oblong capsule with rather woody walls furnished with hooked spines, seeds few; rarely grown in gardens, and usually treated as an annual; member of the Bignoniaceae.

EXPORTS FROM NEW ZEALAND FOR YEARS ENDED 30th JUNE, 1928 AND 1929.

Commodity.	Unit.	Quantity.		Value.	
		1927–28.	1928–29.	1927–28.	1928–29.
New Zealand Produce.				£	£
Butter	Cwt.	1,467,954	1,567,393	11,315,756	12,744,992
Casein	,,	44,372	46,016	141,430	140,913
Cheese	,,	1,529,872	1,661,000	6,360,766	6,889,993
Fish	,,	24,702	24,741	85,562	86,077
Honey	lb.	1,975,300	2,565,795	64,529	89,241
Beef, frozen	Cwt.	692,231	509,738	977,623	808,266
Lamb, frozen	,,	1,865,784	1,879,680	6,669,196	6,925,831
Mutton, frozen	,,	1,095,937	961,247	2,085,607	1,949,919
Pork, frozen	,,	127,297	190,740	374,935	589,609
Beef, salted	,,	4,990	2,365	10,685	5,284
Meats, potted and preserved	,,	68,316	53,495	237,306	198,323
Sausage-skins	lb.	3,715,870	3,574,661	766,345	688,098
Milk, preserved	,,	1,091,497	2,060,813	27,513	49,069
Milk, dried	,,	12,414,035	16,083,585	318,964	361,625
Peas	Centals	207,917	143,817	179,935	112,623
Oats	,,	260,739	25,466	111,155	13,373
Apples, fresh	lb.	39,651,282	32,171,840	496,870	447,509
Hops	,,	406,350	282,979	22,612	15,942
Potatoes	Tons	951	1,056	7,755	8,298
Live-stock	..	..	..	114,224	117,710
Calf-skins	Number	750,408	741,923	245,947	300,197
Hides, horse and cattle	,,	451,476	355,490	903,834	677,552
Rabbit-skins	,,	12,333,438	11,278,431	633,090	555,811
Opossum-skins	,,	133,344	152,430	77,587	102,812
Sheep-skins with wool	,,	1,371,790	1,179,788	488,206	464,303
Sheep-skins, without wool	,,	8,626,621	8,729,575	1,296,428	1,473,253
Wool	Bales	667,225	687,833	16,548,869	15,923,157
Phormium fibre	Tons	13,921	13,620	391,759	371,520
Seeds, grass and clover	Cwt.	75,827	55,935	291,161	172,621
Tallow	Tons	29,510	21,352	882,297	719,099
Coal	,,	120,688	177,343	172,468	247,228
Kauri-gum	,,	4,588	4,517	245,834	247,094
Gold	Ounces	125,855	120,506	518,468	495,456
Silver	,,	437,609	434,501	43,711	43,288
Leather	..	..	..	20,787	16,206
Timber, sawn	Sup. ft.	35,389,421	37,617,329	398,474	408,158
Other New Zealand produce	..	..	..	656,857	827,957
Total	..	..	..	54,184,545	55,288,407
Re-exports	..	..	..	1,434,740	956,343
Total exports	..	..	..	55,619,285	56,244,750

Sterilization of the Churn.—Live steam blown into butter-factory churns after they have been properly washed is a most effective means for keeping them in a sweet condition.

CERTIFICATION OF SEED POTATOES.

CERTIFICATES ISSUED ON FINAL TUBER INSPECTION, SEASON 1928-29.

FOLLOWING is a list of growers whose crops have been subjected to and have passed the tuber inspection in connection with the system of Government certification of seed potatoes conducted by the Department of Agriculture, thus qualifying for certificate. The list comprises those crops passed up to 31st July. Further lists will be published later.

	Acreage.
Aucklander Short-top (N.Z. Sutton's Supreme):—	
F. Brundell, Camside, Kaiapoi	5
W. Eder, R.M.D., Sefton	11
A. J. Rich, R.M.D., Kaiapoi	16
Weeber Bros., Englefield Road, Belfast	4
Aucklander Tall-top (N.Z. Sutton's Supreme):—	
J. Bailey, R.M.D., Kaiapoi	7
Dakota :—	
E. S. Barnes, Hinds, Lowcliffe R.M.D.	2
W. J. Crozier, R.M.D., Mitcham	3
H. M. Marshall, R.M.D., Weedon's, North	2
E. Thompson, R.M.D., Weedon's, North	12
C. E. Walker, jun., R.M.D., West Melton	3
Arran Chief :—	
G. Jones, Vale Royal, Halswell, Christchurch	4
F. Saunders, Studholme Junction	5
Up-to-date :—	
C. E. Walker, jun., R.M.D., West Melton	6
F. Westaway, R.M.D., Courtenay	8

NOTE.—A list of crops which had passed the field inspections and qualified for provisional certificate was published in the May issue of this *Journal*.

VARIETIES OF APPLES AND PEARS EXPORTED, SEASON 1929.

THE following particulars of the varieties of apples and pears exported from New Zealand in the past season have been compiled by the Horticulture Division from export certificates. The figures for apples represent 1-bushel cases, and those for pears crates consisting of three trays, each tray containing from 10 lb. to 12 lb. of fruit.

Apples.—Sturmer Pippin, 276,953; Delicious, 204,368; Jonathan, 155,246; Dunn's, 69,414; Cox's Orange, 47,825; Dougherty, 45,173; Statesman, 25,299; Cleopatra, 11,595; Rome Beauty, 10,767; London Pippin, 9,730; Worcester Pearmain, 8,567; Ballarat, 8,540; Stayman's Winesap, 5,180; Rokewood, 5,075; Lord Wolseley, 4,929; Scarlet Nonpareil, 4,474; Premier, 4,100; Newtown Pippin, 3,869; Tasma, 3,729; Granny Smith, 2,595; Pioneer, 2,360; Alfriston, 2,059; Willie Sharp, 1,838; Adams Pearmain, 1,826; King David, 1,797; Salome, 1,479; Spitzenberg, 1,396; Stark, 1,293; Gravenstein, 938; Shorland Queen, 864; Parlin's Beauty, 814; McIntosh Red, 730; Yates, 776; Ribston Pippin, 670; McLiver's Winesap, 601; Simmonds Winter, 545; Brownlee's Russet, 502; Golden Pippin, 424; Brighton, 412; Blenheim Orange, 409; Boston Russet, 397; Crofton, 386; Hoover, 370; McMahon's White, 357; Stone Pippin, 336; Edward Lippiatt, 295; Frimley Beauty, 207; Scarlet Pearmain, 190; Tasma Pride, 187; Pride of Australia, 171; Baumann's Reinette, 169; Cornish Aromatic, 168; Wagner, 139; Grooby Dessert, 95; Rymer, 88; Giant Jeniton, 71; Glengyle Red, 57; Celo, 55; Shepherd's Perfection, 53; Desert Gold, 38; Winter Banana, 38; Grime's Golden, 12: Total cases, 933,040.

Pears.—Winter Nelis, 19,842; P. Barry, 15,955; Winter Cole, 9,673; Josephine de Malines, 3,840; Beurré Bosc, 1,895; Packham's Triumph, 1,493; Doyenne du Comice, 1,301; Vicar of Winkfield, 1,170; Beurré Clairgeau, 936; L'Inconnue, 668; Keiffer, 532; Glou Morceau, 308; Harrington's Victoria, 278; Beurré Easter, 259; Beurré Diel, 221; Beurré Capiamont, 198; Elizabeth Cole, 169; Duchesse D'Angouléme, 142; Beurré d'Amanli, 104; Twyford's Monarch, 50; Broome Park, 28; Winter Bartlett, 25; Howell, 24: Total crates, 59,111.

GRADINGS OF BUTTER AND CHEESE, SEASON 1928-29.

THE Dominion quantities of butter and cheese graded for export by the Dairy Division during the twelve months ended 31st July, 1929 (the dairy industry year), were as follows :—

Butter : Salted, 79,481 tons ; unsalted, 2,175 tons ; total, 81,656 tons—an increase of 9·27 per cent. compared with the figures for the preceding twelve months.

Cheese : White, 59,058 tons ; coloured, 27,547 tons : total, 86,605 tons—an increase of 14·32 per cent.

In butterfat equivalent the amounts for butter and cheese combined represent a net increase of 10·88 per cent. compared with those for 1927–28, hitherto the peak year. A new high-level record in annual butterfat production has thus been established.

FERTILIZER IMPORTATIONS : JUNE QUARTER.

FOLLOWING are the importations of fertilizers into New Zealand for the three months ended 30th June, 1929 :—

Sulphate of ammonia : United Kingdom, 2,597 tons ; United States, 370 tons. *Calcium cyanamide :* Norway, 2 tons. *Nitrate of Soda :* Chile, 1 ton. *Basic slag :* United Kingdom, 5,025 tons ; Belgium, 31,778 tons ; France, 75 tons. *Bonedust :* India, 50 tons. *Rock phosphate and guano :* Nauru, 42,124 tons ; Makatea, 2,089 tons. *Phosphates (other) :* United Kingdom, 2,035 tons ; Belgium, 12,444 tons ; France, 110 tons ; Morocco, 261 tons. *Kainit :* France, 145 tons ; Germany, 162 tons. *Muriate of potash :* Germany, 3 tons ; *Sulphate of potash :* France, 290 tons ; Germany, 233 tons. *Potash fertilizers (other) :* Belgium, 30 tons ; France, 1,210 tons ; Germany, 1,496 tons. *Sulphate of iron :* United Kingdom, 19 tons ; Australia, 18 tons. *Other fertilizers :* United Kingdom, 3 tons ; Norway, 505 tons.

YIELDS OF POTATOES, SEASON 1928-29.

THE following table has been compiled by the Census and Statistics Office from a recent postal census among growers of 2 acres or over of potatoes, on holdings situated outside city or borough boundaries, together with estimates for areas from 1 acre to 2 acres. The object was to obtain verification of the returns made in connection with the general collection of agricultural and pastoral statistics earlier in the season, which takes place before the main potato crop is dug.

Land District.	Acreage.	Yield of Potatoes at Digging.		
		Table.	Other (Seed, &c.).	Total.
		Tons.	Tons.	Tons.
North Auckland	1,599	6,925	2,084	9,009
Auckland	781	2,804	1,450	4,254
Gisborne	264	654	236	890
Hawke's Bay	532	2,433	739	3,172
Taranaki	211	614	300	914
Wellington	1,564	5,943	3,083	9,026
Nelson	428	1,180	535	1,715
Marlborough	235	623	291	914
Westland	17	84	31	115
Canterbury	12,888	48,982	23,801	72,783
Otago	1,689	8,674	3,685	12,359
Southland	1,096	5,613	2,843	8,456
Dominion, 1928–29	21,304	84,529	39,078	123,607
Dominion, 1927–28	21,693	79,617	41,785	121,402

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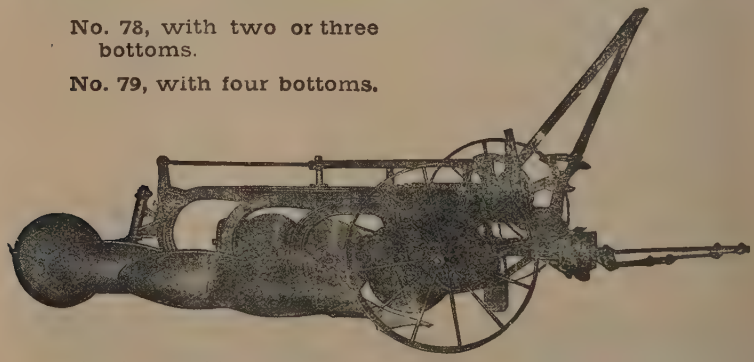

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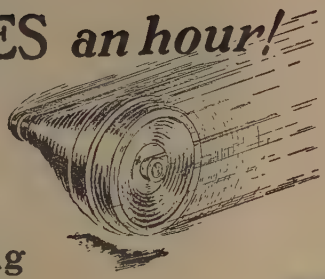

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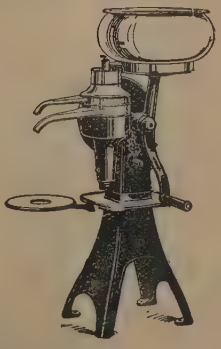

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